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SYSTEM FOR GENERATING, DISTRIBUTING AND RECEIVING AN INTERACTIVE USER INTERFACE

Abstract:

Method and apparatus for generating, transmitting and receiving a user interface for an interactive information distribution system. The user interface is generated in a head end of the system as a digital bitstream and transmitted to subscriber equipment for display. Operation of the user interface is facilitated by functions on both a local level within the subscriber equipment and on a system level within the head end. One embodiment of the user interface is an interactive program guide.

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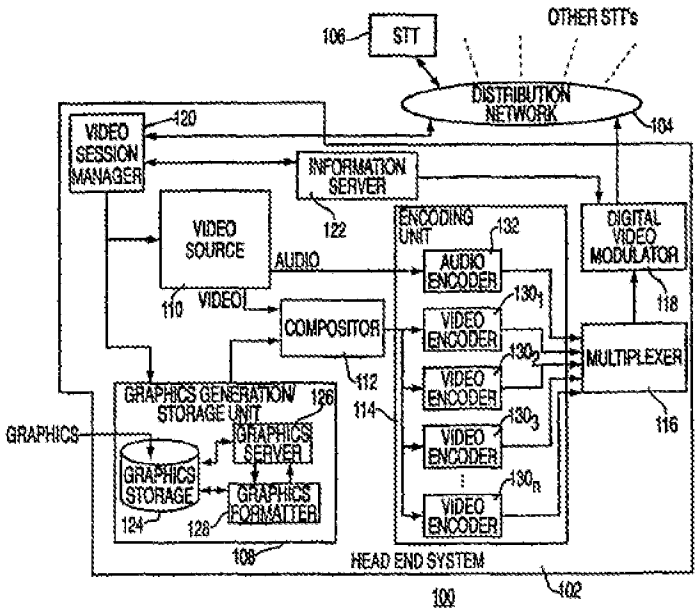


(57) Abstract

Method and apparatus for generating, transmitting and receiving a user interface for an interactive information distribution system. The user interface is generated in a head end of the system as a digital bitstream and transmitted to subscriber equipment for display. Operation of the user interface is facilitated by functions on both a local level within the subscriber equipment and on a system level within the head end. One embodiment of the user interface is an interactive program guide.

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# SYSTEM FOR GENERATING, DISTRIBUTING AND RECEIVING AN INTERACTIVE USER INTERFACE

This application claims benefit of U.S. Provisional patent application serial number 60/093,891 filed July 23, 1998 and 60/129,598 filed April 15, 1999, which are hereby incorporated herein by reference in their entirety.

This application is also a continuation-in-part of U.S. Patent Applications serial number 09/293,526 filed April 15, 1999, which is hereby incorporated herein by reference in its entirety.

## BACKGROUND OF THE DISCLOSURE

### 1. Field of the Invention

The invention relates to communications systems in general and, more specifically, the invention relates to an interactive user interface suitable for use in an interactive multimedia information delivery system.

### 2. Description of the Background Art

Over the past few years, the television industry has seen a transformation in a variety of techniques by which its programming is distributed to consumers. Cable television systems are doubling or even tripling system bandwidth with the migration to hybrid fiber coax (HFC) cable plant. Customers unwilling to subscribe to local cable systems have switched in high numbers to direct broadcast satellite (DBS) systems. And, a variety of other approaches have been attempted focusing primarily on high bandwidth digital technologies, intelligent two way set top boxes, or other methods of trying to offer service differentiated from standard cable and over the air broadcast systems.

With this increase in bandwidth, the number of programming choices has also increased. Leveraging off the availability of more intelligent set top boxes, several companies such as Starsight® and Prevue™ Guide have developed elaborate systems for providing an interactive listing of a vast array of channel offerings, expanded textual information about individual programs, the ability to look forward to plan television viewing as much as several weeks in advance, and the option of automatically programming a VCR to record a future broadcast of a television program.

Unfortunately, the existing program guides have several drawbacks. They tend to require a significant amount of memory, some of them needing upwards of one megabyte of memory at the set top terminal (STT). They are very slow to acquire their current database of programming information when they are turned on for the first time or are subsequently restarted (e.g., a large database may be downloaded to a STT using only a vertical blanking interval (VBI) data insertion technique). Disadvantageously, such slow database acquisition may result in out of date database information or, in the case of a pay per view (PPV) or video on demand (VOD) system, limited scheduling flexibility for the information provider. Furthermore, the user interface of existing program guides do not usually look like a typical television control interface; rather the user interface looks like a 1980's style computer display (i.e., blocky, ill-formed text and/or graphics).

Therefore, it is seen to be desirable to provide an interactive program guide in a manner tending to reduce the above-described problems.

SUMMARY OF THE INVENTION

The invention is an information distribution system comprising a head end wherein a user interface is generated as a digital bitstream, a distribution network for transmitting the user interface to viewers, and subscriber equipment for receiving the user interface and producing a display containing the user interface. The user interface is illustratively embodied in an interactive program guide (IPG).

More specifically, the user interface comprises a graphical region and a video region. In the illustrative IPG embodiment, the graphical region contains a time axis and a channel axis. Certain programming information, for example, program titles are aligned with the axes to form a grid-like pattern that enables a viewer to rapidly comprehend the identity of a program, the time that it is to be broadcast and the channel upon which the program can be found. The IPG further comprises a video region that produces a video image and sound for advertisements of goods and services, previews of programming, and the like. Additionally, the IPG may contain a text region that displays text related to a selected program or other object in the graphics region. Such text may include a description of the selected program, the duration of the program, the actors/actresses in the program, and the like.

The user interfaces may be produced as a plurality of individual interrelated interfaces that enable the viewer to seamlessly move from interface to interface.

Selecting various objects within the interface initiates various information distribution sessions referred to herein as "contexts". For example, a user may initiate a video-on-demand (VOD) context by selecting a VOD button. Similarly, the user may initiate a broadcast television session by selecting a program title in the

program guide graphical region of the interface. Or, a preview context may be initiated if the user selects a program title that is listed as being available in the future.

## BRIEF DESCRIPTION OF THE DRAWINGS

The teachings of the present invention can be readily understood by considering the following detailed description in conjunction with the accompanying drawings, in which:

FIG. 1 depicts a block diagram of an illustrative interactive information distribution system that can benefit from the interactive user interface of the present invention;

FIG. 2 depicts a block diagram of subscriber equipment suitable for use in an interactive information distribution system;

FIG. 3A-3C depict a first embodiment of an interactive user interface;

FIG. 4 depicts the first embodiment of the interactive user interface while emphasizing a new time slot;

FIGs. 5A-5C depicts a flow diagram of a process for moving from one object to another in the first embodiment of the interactive user interface;

FIGs.6A-6C depict a second embodiment of an interactive user interface;

FIGs. 7A-7B depict a flow diagram of a user interaction routine;

FIG. 8 is a third embodiment of an interactive user interface;

FIG. 9 depicts a system stream and its constituent transport streams;

FIG. 10 depicts one example of a program guide layout;

FIG. 11 depicts a second example of a program guide layout; and

FIG. 12 is a table of functional descriptions of keys on an input device that can be used to control the system of the present invention.

To facilitate understanding, identical reference numerals have been used, where possible, to designate identical elements that are common to the figures.

DETAILED DESCRIPTION

This invention is a system for generating, distributing and receiving a unique user interface that is illustratively embodied in an interactive program guide that enables a user to interactively review, preview and select programming for a television system.

Fig. 1 illustrates a high-level block diagram of an information distribution system 100 that generates an interactive user interface in accordance with the present invention. The system 100 comprises a head end 102, a distribution network 104, and a user terminal 106 (commonly referred to as a set top terminal (STT) or set top box, although the terminal may be embedded into a user's television or other video display equipment). For simplicity, the diagram shows a single head-end 102 and a single STT 106, while it is possible to combine multiple head-end systems to provide a desired functionality for the overall system. In a practical application, there are multiple STTs 106 coupled to the network 104 to enable a plurality of users to receive information from the head end 102.

The distribution network 104 is generally a high bandwidth, full duplex communications network, such as a hybrid fiber-coax network. However, the network 104 may

comprise multiple simplex communications channels where together the simplex channels provide bi-directional communications between the head end and the STT, e.g., a forward channel could carry information from the head end to the STT through a cable system, while a back channel could carry information from the STT to the head end via a telephone system.

The head-end 102, which carries the most user interface-related processing power and storage capability, comprises a user interface graphics generation/storage unit 108, video source 110, compositor 112, encoding unit 114, multiplexer 116, video modulator 118, a video session manager (VSM) 120 or multiple VSM' s depending on the viewer/subscriber load, and a video server 122. The IPG generation and encoding apparatus is disclosed in further detail within commonly assigned US patent application _____ (Attorney docket number 168 CIP1), filed simultaneously herewith and incorporated herein by reference.

The VSM 120 performs the command and control functionality and operates as a bridge between the user interface graphics generation/storage unit 108 and the STTs (one of which is depicted as STT 106), being responsible from the establishment and maintenance of the head end-to-STT communication. Specifically, the VSM controls user interface transmission to the STT and controls the response of the system to user requests that are made through the user interface. As shall be described in detail below, the user interface that is transmitted as a digital video bitstream can be used to control and request video and other information from the information server 122. The information server 122 interacts with the VSM 120 to produce requested information for transmission to a particular STT 106, to all the STTs or a particular subset of STTs.

As shall be discussed in detail below, the user interface comprises both graphical information and video information under the control of the VSM 120. The video information for the user interface is produced by the video source 110 (or sources). The graphical information for the user interface is produced in the user interface graphics generation/storage unit 108. The unit 108 comprises a graphics storage unit 124, a graphics server 126 and a graphics formatter 128. The graphics server 126 recalls the graphics information from the storage unit 124 and has the recalled information formatted in the graphics formatter 128 such that the graphics are in an appropriate format for use in a user interface. The server 126 sends a bitmap containing the graphical information for a user interface to the compositor 112.

The compositor combines the graphics with the video to produce a composite video frame sequence. The frame sequence is then encoded within the encoding unit 114. The encoding unit 114 comprises a plurality of real-time MPEG encoders $130_1$, $130_2$, ... $130_n$ (where n is an integer). The encoding unit 114 also comprises an audio encoder 132 that encodes the audio information associated with the video source signal.

The compositor 112 produces a plurality of frame sequences containing graphics and video. For example, to produce interrelated user interfaces, the video is the same in each sequence, but the graphics are different. Each of these sequences is encoded using, for example, a real-time encoder that produces an MPEG compliant bitstream. Each of the bitstreams are coupled to the multiplexer 116 to form one or more transport streams, for example, MPEG compliant transport streams. Each of the encoded user interfaces are identified in the transport streams using a unique identifier, e.g., a program identifier (PID) code. As such, the STT 106 can select a particular user

interface for display by selecting the identifier, e.g., selecting a PID. Once encoded and multiplexed, the transport stream or streams are then coupled to the digital video modulator 118 (e.g., a quadrature amplitude modulation (QAM) modulator) for transmission through the distribution network 104 to the STT 106.

All the encoded bitstreams are temporally aligned in terms of data (i.e., streams depicting different channels or different times are aligned such that stream to stream switching at a decoder may be accomplished in a substantially seamless manner). In addition, the streams are generated in a synchronized manner with respect to clock source, such that GOP structures, sequence headers, I-picture location and other parameters are (if desired) aligned across a plurality of information streams. In this manner, stream splicing may be performed without noticeable video artifacts or audio artifacts, and without excessive latency.

FIG. 9 depicts a diagrammatic representation of a multiple program transport stream suitable for use in the interactive information distribution system of FIG. 1. Specifically, FIG. 9 depicts a diagrammatic representation of a system stream 910 and its constituent multiple transport streams 920.

The system stream 910 comprises, illustratively, a quadrature amplitude modulation (QAM) system stream conveyed by a forward channel within the information distribution system. Specifically, the system stream 910 comprises a plurality of transport streams 920, including transport streams A-H (911-917). Each of the transport streams include at least one of video, audio or data elementary streams or packetized elementary streams (PES). Each elementary stream within the system stream 910 has associated with it a unique packet identification (PID) number.

The transport stream 920 comprises an exemplary plurality of elementary streams associated with a first transport stream 911 (denoted as stream A) and a second transport stream 912 (denoted as stream B). Specifically, first transport stream 911 (i.e., stream A) comprises five elementary streams (921-925), each of which has associated with it a respective PID. The five elementary streams (921-925) of stream A are used to provide video, audio and graphics/data information to a set top terminal such that the set top terminal is capable of producing, via a display device, an IPG display.

In the exemplary embodiment of the invention, the system stream 910 comprises a constant bitrate stream having a bitrate of 3.37125 million bits per second (Mbps), each video PES has a bitrate of 1.05 Mbps, each audio PES has a bitrate of 192 Kbps (44.1kHz audio) or 224 Kbps (44kHz audio) while the remaining bandwidth is utilized by data streams, overhead and the like. It will be appreciated by those skilled in the art that the bitrate of any of these streams may be adapted to, e.g., provide minimum video and/or audio quality levels, provide maximum video and/or audio quality levels, to provide for a maximum number of video and/or audio elementary streams within a transport stream and other system design criteria. The exemplary bitrates are only provided to give a sense of the bandwidth utilization of a presently employed system utilizing the teachings of the invention. The actual bitrates will increase or decrease as the system is upgraded and the like.

The first video stream (PID 1) comprises all the information necessary to produce a video layer for the IPG display, including channel content objects associated with a first group of channels for a defined time period. The second video stream (PID 2) and third video stream (PID 3) differ from the first video stream (PID 1) in that the

second video stream (PID 2) and third video stream (PID 3) comprise the information necessary to produce a video layer including second and third groups of channels.

The audio stream (PID 4) comprises the audio information necessary to produce audio associated with video in the IPG.

The data/graphics stream (PID 5) comprises the title description information that is displayed as a program description object. That is, data/graphics stream (PID 5) comprises a textual description of each title provided by a first group of channels for each of the displayed time slots (e.g., three half hour slots). The textual description of the titles is processed by the graphics processing elements of the STT such that the textual description of a presently highlighted or emphasized title of an indicated channel is presented to a viewer via the graphics layer of the IPG display.

It is important to note that graphics and/or data information may be conveyed to a set top terminal using a data stream associated with a unique PID (as depicted here), as private data within the adaptation headers of the transports stream packets or by other means (e.g., encoded within the video data using, e.g., watermarking techniques). Moreover, since the data stream is used to convey program identification data or other data that does not need to be provided in real time, such data may be used to build a local database of, e.g., favorite programming and the like. However, the favorite programming database does not comprise a program guide database. Rather, the favorite programming database comprises sufficient information to identify the favorite program or title, illustratively, the transport stream and video PID providing the appropriate channel group, an index into the channel group (e.g., third channel from start), an index into the time slots (e.g., second time

slot) and the like. There is no need to store the actual title of the program, only to determine which titles should be highlighted or emphasized in a favorite viewing mode.

If the video in each IPG page has differing amounts of motion, the encoders can encode the video in a slice-based manner. As such, each frame is divided into a plurality of horizontal stripes of macroblocks. Each frame contains stripe start and stop identifiers. The information (pixels and/or macroblocks) between the start and stop indentifiers can be encoded in a different manner than other portions of a given stripe. Consequently, a two dimensional region comprising portions of adjacent stripes can be encoded differently from other portions of the frame. The encoded information from the two dimensional region forms a bitstream that is identified by its own program identifier. At the subscriber equipment, the demodulator/decoder decodes the information in each slice, then reassembles the frame by placing the decoded slices into appropriate locations as identified by the slice start/stop identifiers. The two dimensional regions can be specified to align with the informational video such that the regions can contain video having different motion, i.e., fast versus slow motion. Consequently, one region could contain a slow moving animated character while another region could contain a fast moving sporting event promotion and both regions would be coded and decoded accurately.

FIG. 2 depicts a block diagram of the STT 106 suitable for use in producing a display of a user interface in accordance with the present invention. The STT 106 comprises a tuner 210, a demodulator 220, a transport demultiplexer 230, an audio decoder 240, a video decoder 250, an on-screen display processor (OSD) 260, a frame store memory 262, a video compositor 290 and a

controller 270. User interaction is provided via a remote control unit 280. Tuner 210 receives, e.g., a radio frequency (RF) signal comprising, for example, a plurality of quadrature amplitude modulated (QAM) information signals from a downstream (forward) channel. Tuner 210, in response to a control signal TUNE, tunes a particular one of the QAM information signals to produce an intermediate frequency (IF) information signal. Demodulator 220 receives and demodulates the intermediate frequency QAM information signal to produce an information stream, illustratively an MPEG transport stream. The MPEG transport stream is coupled to a transport stream demultiplexer 230.

Transport stream demultiplexer 230, in response to a control signal TD produced by controller 270, demultiplexes (i.e., extracts) an audio information stream A and a video information stream V. The audio information stream A is coupled to audio decoder 240, which decodes the audio information stream and presents the decoded audio information stream to an audio processor (not shown) for subsequent presentation. The video stream V is coupled to the video decoder 250, which decodes the compressed video stream V to produce an uncompressed video stream VD that is coupled to the video compositor 290. OSD 260, in response to a control signal OSD produced by controller 270, produces a graphical overlay signal VOSD that is coupled to the video compositor 290. During transitions between bitstreams representing the user interfaces, a buffer in the decoder is not reset (flushed). As such, the user interfaces seamlessly transition from one screen to another.

The video compositor 290 merges the graphical overlay signal VOSD and the uncompressed video stream VD to produce a modified video stream (i.e., the underlying video images with the graphical overlay) that is coupled

to the frame store unit 262. The frame store unit 262 stores the modified video stream on a frame-by-frame basis according to the frame rate of the video stream. Frame store unit 262 provides the stored video frames to a video processor (not shown) for subsequent processing and presentation on a display device. The frame store unit 262, in response to a control signal F produce by the controller 270, "freezes" in memory (i.e., does not update) a presently stored video frame such that the video information provided to the video process results in a still image. This is useful when, e.g., a user interface utilizes scrolling information, a telephone number or address is briefly displayed or a user simply wants to view a presently displayed frame for a longer period of time.

Controller 270 comprises a microprocessor 272, an input/output module 274, a memory 276, an infrared (IR) receiver 275 and support circuitry 278. The microprocessor 272 cooperates with conventional support circuitry 278 such as power supplies, clock circuits, cache memory and the like as well as circuits that assist in executing the software routines that are stored in memory 276. The controller 270 also contains input/output circuitry 274 that forms an interface between the controller 270 and the tuner 210, the transport demultiplexer 230, the onscreen display unit 260, the back channel modulator 295, and the remote control unit 280. Although the controller 270 is depicted as a general purpose computer that is programmed to perform specific interactive program guide control function in accordance with the present invention, the invention can be implemented in hardware as an application specific integrated circuit (ASIC). As such, the process steps described herein are intended to be broadly interpreted as

being equivalently performed by software, hardware, or a combination thereof.

In the exemplary embodiment of FIG. 2, the remote control unit 280 comprises an 8-position joy stick, a numeric pad, a "select" key, a "freeze" key and a "return" key. User manipulations of the joy stick or keys of the remote control device are transmitted to a controller via an infra red (IR) link. The controller 270 is responsive to such user manipulations and executes appropriate user interaction routines 300, uses particular dynamic overlays that are available in a dynamic overlay storage 276-2 and uses particular static overlays form a static overlay storage 276-1.

FIGs. 3A-3C depict an illustrative embodiment of a user interface that contains program guide information, i.e., the interface forms an interactive program guide for television systems. This program guide is created entirely in the head end of the information distribution system of FIG. 1 and transmitted to the user's STT for decoding and display. An OSD graphics layer is either stored in the STT or transmitted with the user interface to facilitate a mask and reveal function that provides a technique to emphasize, highlight, mask, or otherwise identify objects (graphical icons and/or text) within the user interface.

Synchronization of objects contained in the user interface with areas of on-screen emphasis is achieved by using bitmap overlay graphics. The overlay graphics are delivered to the STT through in-band data delivery, out-of-band data delivery, vertical blanking interval (VBI) data delivery or other approaches known to those familiar in the art of data delivery in broadband networks. That is, data necessary to implement manipulable screen objects (i.e., those objects that may be selectively emphasized) is provided to the STT via one or more techniques.

Since the overlays can be dynamically transmitted to the STT, the inventive user interface does not require the maintenance of television programming lists in the set top box, it adds a level of interactivity to current broadcast programming guides, it provides a more television-like user experience, and it makes the best economic use of bandwidth in intricate, asset-rich interactive program guides.

In one embodiment of the invention, multiplexed broadcast analog or digital video and static, pre-programmed bitmaps are utilized. In this embodiment, the pre-programmed bitmaps are installed in the STT in, e.g., memory module 276. The bitmaps are x-y grid borders that align with x-y grid borders built into the broadcast video streams, and are modified in color and/or degree of transparency to allow visual emphasis to be associated with a single objects or set of objects.

In another embodiment of the invention, multiplexed broadcast analog or digital video and dynamic, pre-programmed bitmaps are utilized. In this embodiment, a variety of pre-programmed bitmaps are installed in STT. These bitmaps may be x-y grid borders, circles, or any other delineator capable of providing adequate emphasis so that a user may discern the option of set of options representing an actionable field. These may align with borders built into the broadcast video streams and are modified in color and/or degree of transparency to allow visual emphasis to be associated with a single object or set of objects. The STT can move back and forth between one set of bitmaps and another. Synchronization of a particular set of installed bitmaps to a broadcast video stream is achieved through signaling linked to the broadcast video stream either through in-band data delivery, out-of-band data delivery, vertical blanking interval data delivery or other approaches known to those

familiar in the art of data delivery in broadband networks.

In another embodiment of the invention, multiplexed broadcast analog or digital video and dynamic, updateable bitmaps are used. In this embodiment, a variety of pre-programmed bitmaps may or may not be installed in the STT. As in the previous embodiment, these bitmaps may be x-y grid borders, circles, or any other delineator capable of providing adequate emphasis so that a user may discern the option of set or options representing an actionable field. These may align with borders built into the broadcast video streams and are modified in color and/or degree of transparency to allow visual emphasis to be associated with a single object or set of objects. The STT can move back and forth between one set of bitmaps and another. Synchronization of a particular set of installed bitmaps to a broadcast video stream and download of new bitmaps is achieved through signaling linked to the broadcast video stream either through in-band data delivery, out-of-band data delivery, vertical blanking interval data delivery or other approaches known to those familiar in the art of data delivery in broadband networks.

This system can further be extended to implement conditional access by arranging bitmap information in different data blocks according to types of access allowed. Processing of this information would be performed at the head end where a series of descriptors are developed for each on-screen area capable of receiving emphasis. Part of the descriptors contain entitlement "locks" mapping access entitlement to on-screen areas capable of displaying emphasis. At the STT, a series of "keys" exist that map to those channels the user is entitled to view. If one of the keys "fits" any of the locks, the bitmap set linked to the key may receive on-screen emphasis at the STT. Otherwise, the "unavailable"

titles are de-emphasized such that available titles are clearly differentiated from those titles that are not available.

The IPG display 300A of FIG. 3A comprises a first 305A, second 305B and third 305C time slot object, a plurality of channel content objects 310-1 through 310-8, a pair of channel indicator icons 341A, 341B, a video barker 320 (and associated audio barker), a cable system or provider logo 315, a program description region 350, a day of the week identification object 331, a time of day object 339, a next time slot icon 334, a temporal increment/decrement object 332, a "favorites" filter object 335, a "movies" filter object 336, a "kids" (i.e., juvenile) programming filter icon 337, a "sports" programming filter object 338 and a VOD programming icon 333. It should be noted that the day of the week object 331 and next time slot icon 334 may comprise independent objects (as depicted in FIG. 3A) or may be considered together as parts of a combined object.

Additionally, to better understand the invention, FIGS. 3A-3C depict respective display screens of the interactive program guide (IPG) of the guide of FIG. 3A with various objects (icons and/or text) emphasized.

The interactive program guide display 300A comprises a "video layer" and a "graphics layer". In this context, the "video layer" comprises the imagery from the decoded digital video bitstream containing the video and graphical information of the user interface. As described above with respect to FIG. 1, video information, representative of each of the objects (icons and text), is generated at the head end of the system, and transmitted as part of a video stream. Thus, the actual display parameters (i.e., the size, shape, color, position and other visual parameters) associated with each object are entirely controlled at the head end.

The modifiable, via viewer interaction, objects (icons and text) are selected by, for example, a remote control device associated with the STT. Selecting the screen objects causes a locally stored and/or locally generated graphical overlay to identify the selected objects on the screen by associating each manipulable object or element with a corresponding graphical overlay element (e.g., an x-y coordinate box or other element). An overlay element is selectively emphasized or de-emphasized (e.g., selectively shading, highlighting, coloring and the like) via manipulation of the remote control unit.

The IPG display 300A of FIG. 3A is logically divided into two operational regions; a guide region (the graphical region) 302 and an image region (the video region) 304. The guide region 302 comprises the time slot objects 305, channel content objects 310-1 through 310-8 and channel indicator icons 341A, 341B. Channel options that are listed in the guide region can represent any combination of programming offered from a wide range of sources, including but not limited to, over-the-air broadcast, cable broadcast, satellite broadcast, local programming, ad insertion apparatus and can include the full range of pay channels, pay per view, video on demand, near video on demand, internet service, interactive gaming, interactive shopping, free programming, etc. Channel numbers can be virtual in nature, and they can be remapped in either the set top box or the head end equipment to correspond to the service being delivered.

Delivery of pay per view (PPV), near video on demand (NVOD), video on demand (VOD), interactive gaming, interactive shopping, internet, video classified ads, and other services can be integrated into this system in a two-way cable environment through the use of cable modem technologies or other back-channel methods known to those

familiar in the art of enabling such services in a network environment. This guide region may further be used to provide access to pay television services such as subscription services like HBO®, Showtime®, etc., in a two-way cable environment through the use of cable modem technologies or other back-channel methods known to those familiar in the art of enabling such services in a network environment.

The image region 304 comprises the remaining objects that are delineated above. When a user or viewer is interacting with the program guide of the present invention, only one of these two regions will be active at any one time. Some keys or controls utilized by a viewer to control the IPG will operate differently, depending upon which region is active. The operational differences between the two regions will be described in more detail below.

Referring to the guide region 302 of FIG. 3A, it can be seen that the first time slot 305A is emphasized by a time slot highlighting object 305H. The slot 305A is emphasized with respect to the other time slots 305B and 305C, which can be said to be de-emphasized. The slot 305A can be emphasized by highlighting the slot using a colored highlighting overlay graphic 305H, or the highlighting graphic may provide a 0% opacity window (a transparent window) through which the slot text 305A can be seen and the others slots may be overlaid with a graphic having an opacity that is more than 0%, e.g., 25, 50 or 75 percent opacity. The level of opacity is selected to facilitate clear emphasis of the selected time slot by muting the intensity of the un-selected slots. Similarly, it can be seen that each respective first title object 311A of each of the plurality of channel content objects 310-1 through 310-8 is also emphasized or

highlighted by a title highlighting object 311H. Time slot emphasis is coordinated with title slot emphasis. That is, if the first time slot object 305A is emphasized or highlighted, then the first title object 311A of each of the plurality of channel content objects 310-1 through 310-8 is also emphasized or highlighted. Similarly, if the second time slot object 305B is emphasized or highlighted as in FIG. 3B, then the second title object 311B of each of the plurality of channel content objects 310-1 through 310-8 is also emphasized or highlighted. Lastly, if the third time slot 305C is emphasized as shown in FIG 3C, then the third title objects 311C are emphasized or highlighted. This coordinated highlighting or emphasizing of time slot 305 and title 311 objects assists the viewer in determining which titles within the respective channel content objects 310-1 through 310-8 are associated with which time slot.

Alternatively, the coordinated emphasis or highlighting of time slot and title objects is accomplished by using the graphics layer to adjust a color, brightness or other attributes of an object, or display area surrounding the object. For example, an x-y coordinate grid (a rectangular cell) or other shape surrounding an object to be highlighted or emphasized may be changed in color or brightness level such that the surrounded or proximate object is emphasized. Similarly, an x-y coordinate grid or other shape surrounding an object to be non-highlighted or de-emphasized may be changed in color or brightness level such that the surrounded or proximate object is de-emphasized.

In a system comprising 80 channels of information, where channels are displayed in 8-channel groups having associated with them three half hour time slots, it is necessary to provide 10 video PIDs to carry the present-time channel/time/title information, one audio PID to

carry the audio barker and/or a data PID (or other data transport method) to carry the program description data, overlay data and the like. To broadcast program information up to 24 hours in advance, it is necessary to provide 128 (8*24/1.5) video PIDS, along with one audio and, optionally, one or more data PIDs. The amount of time provided for in broadcast video PIDs for the given channel groups comprises the time depth of the program guide, while the number of channels available through the guide (compared to the number of channels in the system) provides the channel depth of the program guide. In a system providing only half of the available channels via broadcast video PIDs, the channel depth is said to be 50%. In a system providing 12 hours of time slot "look-ahead," the time depth is said to be 12 hours. In a system providing 16 hours of time slot "look-ahead" and 4 hours of time slot "look-back," the time depth is said to be +16/-4 hours.

The program description region 350 of the image region 304 is used to display a description of a presently indicated (emphasized) title. The description comprises, illustratively, one or more of a brief textual description of the title, title start and end times, title run time, title ratings (e.g., MPAA or other ratings), title reviews (e.g., "thumbs-up" or "thumbs-down" or other qualitative indicia), ranking of title in comparison to other titles (e.g., popularity, aggregated positive or negative viewer feedback) and the like.

The pair of channel indicator icons 341A, 341B (or a single channel indicator icons 341A or 341B) is used to indicate which of the plurality of channel content objects 310-1 through 310-8 includes a highlighted or emphasized title object 311 having associated with it title description within the program description icon 350. That is, the channel indicator icons 341A, 341B provide a

visual indication of a presently indicated channel to the viewer.

It is important to note that the video barker 320 of FIG. 3A is, itself, an object that may be selected in some embodiments of the invention. Specifically, in such an embodiment where the video barker 320 is used to present a movie trailer, selection of the video barker object 320 by the user implies a desire to view that movie in, e.g., a video-on-demand context. Thus, in an embodiment of the invention where the video barker comprises an active or selectable object, selection of the video barker brings the user to a video-on-demand interaction screen where the user is provided the opportunity to purchase the movie presented in the video barker. Similarly, where the video barker is used to present merchandise or other products and/or services for sale, selection of the video barker results in the user being brought to an interaction screen suitable for fulfilling a user's desire to purchase or shop for such goods and/or services (e.g., an advertisement from a store is associated with a virtual mall, an advertisement for a restaurant is associated with a food coupon retrieval system, either virtual or via regular mail after entering a name and address).

Referring to FIG. 3B the second channel 310-2, which is indicated by the channel icons 341A and 341B, includes a second title 311B that is associated with the highlighted or emphasized second time slot 305B. In one embodiment of the invention, selecting this title (i.e., pressing the "select" key when the guide region is active) which is to be presented in the future, results in the user being transferred to a preview screen depicting a preview of the selected title. For example, in the case of the selected title being a television sitcom to be broadcast in, e.g., 20 minutes from the present time, selecting that title results in the display of a preview

information screen related to the sitcom. Similarly, in the case of the selected title being a boxing match or other sporting event, usually associated with a pre-game show or pre-fight program of some sort on one or more channels, the user is displayed a screen in which he or she may select which of these pre-event programs to view. Alternatively, the viewer is displayed a screen describing the upcoming fight.

When the guide region 302 is active, user manipulations of left or right arrow keys on, e.g., a remote control device, result in a change in the highlighted or emphasized time slot; while user manipulations of up or down arrow keys result in a change in the indicated channel. In the case of a change in time slot or channel indication, contents of the title description information, which is displayed in the program description region 350, is also changed. The guide region 302 becomes inactive and the image region 304 becomes active when the user utilizes the left or right arrow keys to highlight or emphasize an object within the image region (i.e., icons 331-339).

As noted above, the video streams for the IPG display may be included as a PES within a single transport stream. Thus, a user desiring to view the next 1.5 hour time interval (e.g., 9:30 - 11:00) may activate a "scroll right" object (or move the joystick to the right when a program within program grid 302 occupies the final displayed time interval). Such activation will result in the controller of the STT noting that a new time interval is desired. The video stream corresponding to the new time interval will then be decoded and displayed. If the corresponding video stream is within the same transport stream (i.e., a new PID), then the stream will be immediately decoded and presented. If the corresponding video stream is within a different transport stream, then

the different transport stream will be extracted from the broadcast stream and the appropriate video stream will be decoded and presented. If the corresponding transport stream is within a different broadcast stream, then the different broadcast stream will be tuned, the different transport stream will be extracted from the different broadcast stream and the appropriate video stream will be decoded and presented.

It is important to note that each extracted video stream is associated with a common audio stream. Thus, the video/audio barker function of the program guide is continuously provided, regardless of the selected video stream.

Similarly, a user interaction resulting in a prior time interval or a different set of channels results in the retrieval and presentation of an appropriate video stream. If the appropriate video stream is not normally part of the broadcast video streams, then a pointcast session is initiated. That is, the STT sends a request to the head end via the back channel requesting a particular stream. The head end processes the request, retrieves the appropriate stream from the information server, incorporates the stream within a transport stream as a video PID (ideally the transport stream currently being tuned/selected by the STT) and informs the STT which PID should be demultiplexed, and from which transport stream it should be demultiplexed. The STT then retrieves the appropriate video PID. In the case of the appropriate video PID being within a different transport stream, the STT must first demultiplex the different transport stream (possibly even tuning a different QAM stream within the forward channel).

Upon completion of the viewing of the appropriate stream, the STT indicates to the head end that the STT no

longer needs the stream, whereupon the head end tears down the pointcast session.

FIG. 4 shows an IPG display 400 illustrating the user interface in the next time slot, which is 9:30 to 11:00 PM. The next time slot object 334 in FIG. 3A indicates 9:30 PM as each time slot in the exemplary embodiment comprises one and a half hour time interval. Upon viewer selection of object 334 in FIG. 3A, the time slot in the guide region 302 changes to 9:30 PM to 11:00 PM. Therefore, the time slot objects 305A, 305B and 305C in FIG. 4 indicate 9:30, 10:00, and 10:30, respectively. The next time slot object 334 also changes and indicates 11:00 PM in FIG. 4.

When the image region 304 is active, activations of up or down arrows by a user via a remote control device results in incrementing and decrementing the indicated next time slot. Upon receiving a select command, the video PID including the channel information for the time indicated by the selected next time slot object 334 is retrieved. In the case of that video stream being part of a currently broadcast or currently used video stream (e.g., another user had requested this stream), the head end provides information to the set top terminal enabling the set top terminal to identify the video PID including the appropriate channel guide information. The set top terminal then retrieves the appropriate video PID. If the selected video PID is located in a different transport stream, then the audio PID is also retrieved from the new transport stream.

This process of moving from one program guide page to another is depicted in FIGS. 5A-5C. FIG. 5A depicts a flow diagram 500A illustrating contextual changes in the IPG display screen 300A in response to horizontal increment and decrement (right/left) commands, such as right arrow and left arrow key activations from, e.g., a

remote control. Each of the objects depicted in the contextual flow diagram comprises a video object having associated with it a graphical overlay providing emphasis to indicate an active (i.e., selectable) object or de-emphasis to indicate a non-active object (i.e., non-selectable).

The objects depicted in the flow diagram 500A of FIG. 5A comprise a subset of the objects shown in the IPG display screen 300A of FIG. 3A. Specifically, the objects depicted in the contextual flow diagram 500A of FIG. 5A comprise, in the order of emphasis in response to a right arrow or horizontal increment: the first 305A, second 305B and third 305C time slot objects of the IPG display screen guide region. These objects are followed by the following IPG display screen image region objects: day of week identification object 331, next time slot object 334, "favorites" filter object 335, "movies" filter object 336, a "kids" filter object 337 "sports" filter object 338 and VOD user interface object 338. It should be noted that while the objects depicted in the contextual flow diagram 500A comprise objects depicted in the IPG display screen 300, other IPG display screens may be adapted accordingly.

For purposes of this discussion it is assumed that the first object to be highlighted or emphasized is the first time slot object 305A. Referring to FIG. 5A, in response to a first right arrow or horizontal increment 501, the first time slot object 305A is de-emphasized and the second time slot object 305B is emphasized; in response to a second right arrow or horizontal increment 502, the second time slot object 305B is de-emphasized and the third time slot object 305C is emphasized; in response to a third right arrow or horizontal increment 503, the third time slot object 305C is de-emphasized and the day of week identification object 331 is emphasized, and so on for the (504) next time slot object 334; (505) "favorites"

object 335; (506) "movies" selection object 336; (507) "kids" selection object 337; (508) "sports" selection object 338; (509) "VOD" selection object 436 and, finally, is returned to the (610) first time slot object 305A.

The graphical representation of FIG. 3A is divided into guide region objects (the three timeslots 305A-305C) and image region objects (the remaining objects 331-338). The functionality of vertical increment (up arrow), vertical decrement (down arrow), page up, and page down depends upon which region is activated. The differences between guide region and image region key functionality will be discussed in more detail below with respect to FIGS. 5B and FIGS. 5C.

When the guide region is active (any of objects 305A-305C emphasized), the up and down arrow keys are used to scroll through the various portions of the guide region. That is, the channel content object number (310-1 through 310-8) is changed by one (i.e., incremented or decremented) in response to up arrow or down arrow activation. Similarly, the displayed video stream is changed (via selecting the next or prior video PID) in response to page up or page down key activation. Thus, active guide region functionality provides for navigation of the various video streams providing broadcast IPG screens to a user.

When the image region is active (any of objects 331-338 emphasized), the up and down arrow keys are used to change the next time slot object 334, while the page up and page down keys are used to change the day of week identification object 331. Specifically in response to an up arrow key activation, the next time slot object 334 is incremented by, e.g., 1.5 hours by selecting the video PID including the guide information for the next three time slot objects of the current channels presented in the guide region. Similarly, in response to a page up key

activation, the day of week identification object 331 is incremented by 1 day by selecting the video PID including the guide information for the next day of the current channels presented in the guide region.

FIG. 5B depicts a contextual flow diagram to illustrate the changes in the IPG display screen 300A in response to vertical increment and decrement (up/down) commands received while a guide region object is highlighted or emphasized.

The objects depicted in the contextual flow diagram 500B of FIG. 5B comprise a subset of the objects shown in the IPG display screen 300 of FIG. 3. Specifically, the objects depicted in the contextual flow diagram 500B of FIG. 5B comprise the channel content object 310-1 through 310-8 as indicated by the channel indicator objects 341A and/or 341B. In response to successive down arrow or vertical decrement key activations, the indicated channel content object traverses from 310-1 to 310-2 (520); 310-2 to 310-3 (521); 310-3 to 310-4 (522); 310-4 to 310-5 (523); 310-5 to 310-6 (524); 310-6 to 310-7 (525) and 310-7 to 310-8 (526). Similarly, activating an up arrow or vertical increment key changes the indicated channel in the reverse order.

In response to a down arrow activation while channel object 310-8 is indicated, the "next" video PID is selected for display. That is, the video PID containing the next eight channels to be displayed for the currently viewed time slot is selected. If the last eight channels are presently being displayed, then the video PID associated with the first eight channels is selected (i.e., channel "roll-over"). In the case of the "next" video PID being part of a different transport stream, the related transport stream is retrieved and the appropriate video PID and the associated audio and data PIDs are extracted.

In response to an up arrow activation while channel object 310-1 is indicated, the "prior" video PID is selected for display. That is, the video PID containing the prior eight channels to be displayed for the currently viewed time slot is selected. If the first eight channels are presently being displayed, than the video PID associated with the last eight channels is selected (i.e., channel "roll-under") In the case of the "prior" video PID being part of a different transport stream, the related transport stream is retrieved and the appropriate video PID and the associated audio and data PIDs are extracted.

FIG. 5C depicts a contextual flow diagram to illustrate the changes in the IPG display screen 300A in response to vertical increment and decrement (up/down) commands received while an image region object is highlighted or emphasized.

The object depicted in the contextual flow diagram 500C of FIG. 5C comprises the next time slot object 334 shown in the IPG display screen 300A of FIG. 3A. Specifically, when an image region object is activated, the next time slot object 334 is incremented or decremented in response to, respectively, an up arrow or vertical increment key activation and a down arrow or vertical decrement key activation. In the exemplary embodiment, the next time slot object 334 is delineated in 1.5 hour intervals (i.e., the time slot following the three time slots 305A, 305B and 305C of the guide region) for a 24 hour period.

In one embodiment of the invention, the operations described in the contextual flow diagram 5C only occur if the next time slot object 334 or a combined object comprising the day object 331 and next time slot object 334 are highlighted or emphasized. In another embodiment of the invention, the operations described in the

contextual flow diagram 5C occur when any image regions object is highlighted or emphasized.

In response to successive up arrow or vertical increment key activations, the indicated next time slot object traverses from the actual (with respect to the present time) next time slot (551) to a next time slot + 3 (552) via path 5512; a next time slot + 6 (553) via path 5523; a next time slot + 9 (554) via path 5534 and so on up to a next time slot + 21 (558) via path 5578. An additional up arrow or vertical increment key activation results, in the present embodiment, in a return to the next time slot (551) via path 5581. Similarly, activating a down arrow or vertical decrement key changes the indicated next time slot object in the reverse manner, except for one case. Specifically, in the case of activating a down arrow or vertical decrement key when the next time slot (551) is indicated, the system enters a time shift mode 556 via path 5516.

FIG. 6A depicts a second embodiment of a user interface in accordance with the present invention. The first time slot 305A is emphasized and that only the first title object 311A within each of the channel content objects 310 is shown. That is, only the title object associated with the emphasized time slot is "revealed," while the title objects associated with the non-emphasized time slots are "masked." This "mask and reveal" method of presentation provides an IPG display that some viewers find more desirable than the previously described (with respect to FIGs. 3A-3C) muting or reduced opacity de-emphasis method of presentation. However, the muting or reduced opacity de-emphasis method of presentation does present more information to the viewer in each IPG display.

Referring simultaneously to FIGS. 6A through 6C, FIG. 6A depicts an IPG display 600A having the first time slot

305A emphasized and each of the title objects 311A associated with the first time slot being revealed, while each of the title objects 311B, 311C associated with the non-emphasized time slots 305B and 305C are masked (hidden). In FIG. 6A, the first time slot object 305A is emphasized, and the second and third time slots 305B and 305C are de-emphasized; in FIG. 6B the second time slot object 305B is emphasized, while the first and third time slot objects 305A and 305C are de-emphasized; and in FIG. 6C the third time slot object 305C is emphasized while the first and second time slot objects 305A and 305B are de-emphasized. Note that in all cases the operation of the title description object 350 remains unchanged, as does the operation of the video barker 320 and all the other functional elements of the program guide. By using the mask and reveal technique, the irrelevant information in the IPG is effectively removed to simplify the user interface. When the user has previously defined certain programs as favorites, the subsequent selection of the "favorites" icon 335 masks all non-favorite programming. Similarly, selecting the "sports" icon 338 masks all non-sports programming.

FIGS. 7A and 7B together as FIG. 7 comprise a user interaction method 700 according to the invention. FIG. 7B also depicts a diagram representing an alignment between FIG. 7A and FIG. 7B. FIG. 7 depicts a user interaction routine 700 according to the invention. The routine 700 is entered at step 702, when the subscriber equipment is initially powered on or initialized. The routine then proceeds to step 704, the first or default stream is tuned and demodulated. The routine 700 then proceeds to step 706, the first or default video stream and associate audio stream is demultiplexed and displayed. The routine 700 then proceeds to step 708, where an appropriate overlay is retrieved and displayed along with

the displayed or presented video stream. The routine 700 then proceeds to step 710, where the STT waits for user input via, e.g., remote control device 280. Upon receipt of user input, the routine proceeds to step 712 to evaluate the input. The routine 700 then proceeds to step 714, where a query is made as to whether the user interaction abstraction level is contextual, i.e., the contextual IPG changes that requires information to be sent from head end or local/contextual that carries interaction processes both locally at STT and request information from head end.

If the query at step 714 indicates that a contextual change is requested by the viewer, then the method 700 proceeds to step 716, where a query is made for the pressed key type. If a RETURN key is pressed, the algorithm proceeds to 718, where the system reacquires the previous context. For example, the viewer may have previously been viewing a movie preview and, at the end of the preview, the viewer has been returned to the IPG context. If the viewer then presses the RETURN key, he or she is returned to the previous context and the movie preview is re-displayed. At the end of the requested context presentation, the method 700 returns to step 710.

If, at step 716, the viewer presses a SELECT key to select a presently emphasized or highlighted object, the method 700 proceeds to step 720 where the context is identified as being changed. At step 722, the new context functions are performed. For example, the user may have highlighted and then selected the "video-on-demand" icon. Such a selection will cause the system to enter the video-on-demand (VOD) context. In this context, the STT is sent a VOD navigator in a pointcast manner to enable the user to select a movie to view. Other context changes result when the viewer selects the video barker, any of the programs in the guide region of the IPG display, and the

like. Barker selection causes the system to enter a barker defined context, i.e., a movie, if the barker was displaying a movie preview; a sales page, if the barker was advertising a product; and so on. The selection of a program available for viewing in the current time frame causes the system to send the program video to the STT's either as pointcast or broadcast stream. The stream type depends upon the program selection. The selection of a program listed in an upcoming time slot results in display of a preview of the selected program.

It should be noted that in one embodiment of the invention, the head end causes multiple STTs to "share" a pointcast stream. That is, if a first STT request a video stream that is currently being provided to a second STT, the head end will guide the first STT to the PID and (optionally) transport stream providing the video stream to the second STT. If the second STT indicates to the head end that it is finished viewing the video stream, the head end determines if another STT (i.e., the first STT) is still utilizing the video stream. If the stream is still being utilized, the pointcast session is not torn down (at least not with respect to the STT(s) utilizing the video stream). In this manner, forward channel bandwidth and head end video processing resources are conserved.

Sharing of pointcast streams is especially useful within the IPG display context where relatively low channel depth and/or time depth is used. In such a case, it is quite likely that several users will want to contemporaneously view information that may be packaged within the same video stream. Thus, an adaptive narrowcast (or group pointcast) system is provided, wherein the head end is able to adapt resource allocation to the sub-set of users exhibiting a coordinated need for information. These adaptive narrowcast session are

created and torn down as necessary in response to changing user demand. In the event of a very high level of utilization streams associated with a particular channel group(s) or time slots, the head end may determine that the processing, memory and bandwidth resources required to create, manage and tear down the narrowcast of such streams is greater than the resources required to simply provide such streams as broadcast streams. in one embodiment of the invention the head end will adapt the depth of the broadcast stream to accommodate the high utilization stream(s). This accommodation does not require the addition of contiguous channel groups or time slots, only the addition of PIDs allocate to the high utilization stream(s).

If the query at step 714 indicates that local interactivity is requested by the user, then the method 700 proceeds to step 740, where a query is made to identify the type of key pressed by the user. If the query at step 740 indicates that a freeze key has been pressed, then the method 700 proceeds to step 734, where the video frame presently stored in the frame store unit 262 is frozen. That is, the frame store unit 262 is not updated by subsequent video frames until such time as a freeze key or other key is pressed. The method 700 then proceeds to step 710, where the processor waits for user input.

If the query at step 714 indicates that one of an increment or decrement key has been pressed (e.g., a channel indication increment or decrement command), then the method proceeds to step 744. If the query at step 740 indicates that one of the page up or page down keys has been depressed, then the method 700 proceeds to step 742.

At step 742, a query is made to determine whether the page up key has been pressed. If this is the case, then the method 700 proceeds to step 732. Then, a query is

made at step 732 to determine whether the PID being viewed is the first PID in the transport stream. If this is the case, then, depending on the organization of the video PID's in a single or multiple transport streams, either it is tuned to the previous broadcast stream or it is wrapped around to the last video PID in the same transport stream. If the query at step 732 reveals that the PID is being viewed is not the first PID in the transport stream, then the previous video PID in the same transport stream is demultiplexed and displayed. If the query at 742 indicates that a page down key has been pressed, then the method 700 proceeds to step 726. Then, a query is made at step 726 to determine whether the PID being viewed is the last PID in the transport stream. If this is the case, then, depending on the organization of video PID's in a single or multiple transport streams, either it is tuned to next broadcast transport stream or it is wrapped around to the first video PID in the same transport stream. If the query at step 726 reveals that the PID being viewed is not the last PID in the transport stream, then the next video PID in the same transport stream is demultiplexed and displayed.

At step 744 a query is made as to whether an increment key has been pressed. If the query at step 744 is answered affirmatively, then the method 700 proceeds to step 746. If the query at step 744 is answered negatively (i.e., a decrement key has been pressed), then the method 700 proceeds to step 748.

At step 746, a query is made as to whether the upper most channel of the program guide (i.e., channel content object 310-1) is presently indicated by channel icons 341A and 341B. If the query at step 746 is answered affirmatively, then the method 700 proceeds to step 732 and continues as described above with respect to step 732.

If the query at step 746 is answered negatively, then the method 700 proceeds to step 750.

At step 750 a query is made as to whether an upper threshold level has been reached. An upper threshold level is a pre-set channel number (in the group of channels of an IPG page) at which a request for a prior channel PID should be made if such a prior channel PID is unavailable. If the query at step 750 is affirmatively answered, then the method 700 proceeds to step 754. If the query at step 750 is negatively answered, then the method 700 proceeds to step 758.

At step 754, a determination is made as to whether the prior channel group is available. An available channel group is a channel group within a video stream that is presently being broadcast or narrow cast or pointcast to one or more set top terminals. As previously noted, the set top terminal receives information associating each channel group with a particular video stream as identified by a unique PID. If the unique PID, or the stream associated with the unique PID is not being broadcast, narrow cast or pointcast, then it is appropriate at this time to request that the head end begin a pointcast session so that the prior channel group can be received by the set top terminal without undue delay (e.g., without the user experiencing latency due to the amount of time required to process and respond to a request for a video stream). If the query at step 754 is answered negatively, then the method 700 proceeds to step 756, where a request for the prior channel group is sent to the head end for processing. The method then proceeds to step 756. If the query at step 754 is answered affirmatively, then the method proceeds to 758.

At step 758, the channel indicator is moved up by one channel content object 310. That is, the channel content object immediately above the presently indicated channel

content object is now indicated. The method 700 then proceeds to step 710, to wait for the next user input.

If the query at step 744 is negatively answered, then the method 700 then proceeds to 748. At step 748, a query is made as to whether the presently indicated channel is the last lower channel. That is, a query is made as to whether the presently indicated channel is channel content object 310-8, in FIG. 3A. If the query at step 748 is answered affirmatively, then the method 700 proceeds to step 726. It is important to note that if the presently indicated channel is associated with channel content object 310-8, then a decrement command, as noted above with respect to FIG. 5B and path 532 requires the selection of the next channel PID to display the upper most channel of the next channel group (i.e., channel content object 310-1 of the next channel group). If the query at step 748 is answered negatively, then the method 700 precedes to step 760.

At step 760 a query is made as to whether a lower threshold has been reached. If the query at step 760 is answered negatively, then the method 700 proceeds to step 768. If the query at step 760 is answered affirmatively, then the method 700 proceeds to step 762.

At step 762 a determination is made if the next channel group is available. This is, in a manner similar to that described above with respect to step 752, a determination is made if a presently broadcast, narrowcast or pointcast stream includes an IPG guide display including information related to the next channel group. The method 700 then proceeds to step 764.

At step 764 a query is made as to whether the next channel group is in fact available. If the query at step 764 is answered affirmatively, then the method 700 proceeds to step 768. If the query at step 764 is

answered negatively, then the method 700 proceeds to step 766.

At step 766, a request is made by the set top terminal to the head end for the head end to send information associated with the next channel group (i.e., the guide and image portions of the IPG display including the next channel group, or alternatively, a previously stored video screen including the appropriate information). As previously noted, by requesting such information at this point the apparent latency of the system, as experienced by the user, is greatly reduced. The method 700 then proceeds to step 768.

At step 768 channel icons 341A and 341B are decremented or moved down by one channel content object 310. The method 700 then proceeds to step 710, where it waits for user input.

FIG. 8 depicts third embodiment of an interactive program guide (IPG) 800 according to the invention. Specifically, the exemplary interactive program guide screen 800 comprises a time of day/date (TOD) indicator 805, a promotional "splash" icon 810, a cable system or provider logo 815, a video barker 820 (and associated audio barker), a program time indicator 825, a channel number indicator 830, a channel identifier (text or logo) 835, a pair of channel display decrement icons 840a and 840b, a pair of channel display increment icons 845a and 845b, a temporal increment icon 848, a temporal decrement icon 847, a program grid 850 and a scrolling promotional banner 855. The interactive program guide display 800 is displayed on a television screen or other video presentation device in, e.g., the home of a subscriber to a cable television or other information distribution system utilizing the interactive electronic program guide.

FIG. 12 depicts a tabular representation of the functions of various keys on an input device, such as a

remote control, during guide region and image region operation. The functions of some of the depicted keys have been described above and, therefore, will not be additionally discussed. Specifically, FIG. 12 depicts the guide region and image region functionality of the increment (up arrow), decrement (down arrow) page up, page down, horizontal increment (move right), horizontal decrement (move left) select and add/remove keys. The Select key is used to select a highlighted or emphasized object to, e.g., enter a different operating mode (image region response) of tune an indicated channel (guide region response). The add/remove key is used to add a presently tuned channel to the list of favorites. If the presently tuned channel is already on the list, then the channel is removed form the list of favorites. Optionally, the viewer is queried as to whether the viewer really intends to remove the channel from the favorites list.

FIG. 8 depicts third embodiment of a display screen of an interactive program guide (IPG) 800 that is formed in a manner similar to that described above with respect to the IPG display 300 of FIG. 3. The primary differences between the IPG displays of FIG. 8 and FIG. 3A are as follows:

1. The IPG display 300 shows only the programs at a specified time interval, such as 8:30 to 9 PM, whereas display 800 shows the complete time interval.
2. The IPG display 300 does not contain grid structure to show the program versus time interval information. It is a completely unique user interface design.

3. The IPG display 800 of FIG. 8 utilizes a program grid 850 to present programming information, whereas the IPG display 300 of FIG. 3A utilizes an enhanced "mask and reveal" technique to present more information to a viewer while reducing the amount of display clutter experienced by the viewer in navigating through the available programming choices. Only the desired programs are shown.
4. the IPG display 300 of FIG. 3A includes a program description object 350 that is used to display, illustratively, a brief textual description of a program occupying a presently indicated time slot of a presently indicated channel.

In addition to these differences, there can be found many other ones to differentiate the two user interfaces. However, the supporting system is designed to produce either of these interfaces.

Upon receiving a "select" entry from the remote control unit, the set top terminal transmits, via a back channel or some other communications path, the information that identifies the selected object to the head end. It is important to note that, as with the mask and reveal technique, changing the emphasis of an object or element is performed entirely at a local level within the STT. That is, there is no change in the actual video information transmitted by the head end to the subscriber. Only the graphical overlay layer on the display is changed within the STT to facilitate object emphasis.

The interactive program guide display 800 (i.e., the video layer provided by the head end) depicts a program offering of 10 channels within a 1.5 hour time interval. Since there are 24 hours in a day, 16 video streams (each representing one program guide screen) are required to depict 24 hours of program offerings of 10 channels. These 16 video streams may be included within a single

transport stream. Thus, a user desiring to view the next 1.5 hour time interval (e.g., 9:30 - 11:00) may activate a "scroll right" object (or move the joystick to the right when a program within the program grid 850 occupies the final displayed time interval). Such activation will result in the controller of the STT noting that a new time interval is desired. The digital video stream corresponding to the new time interval will then be decoded and displayed, i.e., the STT selects the bitstream within the transport stream that represents the desired program guide and decodes that bitstream. The process for selecting and decoding a bitstream is accomplished in the same manner as described above.

FIGS. 10 and 11 are graphical depictions of two different program guide layout formats. FIG. 10 depicts a program guide screen comprising a horizontally disposed guide region 1010 occupying a large portion of a lower half of the IPG screen 1001, and a video barker or image portion 1020 occupying a portion of the top half of the screen 1001. FIG. 11 depicts a program guide screen comprising a horizontally disposed guide region 1110 occupying a large portion of a lower half of the IPG screen 1102, and a video barker or image portion 1120 occupying a portion of the top half of the screen 1102.

The foregoing description details three layouts for a user interface, however, any user interface layout that can be produced in a head end as a digital video bitstream and sent to a user is considered to be within the scope of the invention. As a further example, the informational video could be a program that is being watched and the graphical imagery could be an HTML page that is associated with the program. The program video could also be contained in the IPG display such that the viewer can continue watching a program while browsing the IPG for other program scheduling information.

Although various embodiments which incorporate the teachings of the present invention have been shown and described in detail herein, those skilled in the art can readily devise many other varied embodiments that still incorporate these teachings.

What is claimed is:

1. A system for generating and using an interactive user interface comprising:

a head end for generating a bitstream representing an encoded user interface;

a distribution network coupled to said head end; and

subscriber equipment, coupled to said distribution network, for decoding and displaying said user interface.

2. The system of claim 1 wherein the head end comprises:

a user interface generator for producing said bitstream; and

a modulator.

3. The system of claim 2 wherein the user interface generator comprises a user interface source and an encoder.

4. The system of claim 3 wherein said user interface source comprises:

a video source;

a graphics source; and

an overlay source.

5. The system of claim 4 wherein said user interface generator produces a plurality of bitstreams and further comprises a mulitplexer for assigning bitstream identifiers to each of said bitstreams in said plurality of bitstreams.

6. The system of claim 1 wherein the distribution network is a hybrid fiber-coax network.

7. The system of claim 1 wherein the subscriber equipment comprises:

a demodulator;

a demultiplexer; and

a decoder.

8. A method of generating and using an interactive user interface comprising the steps of:

generating, within a head end of an information distribution system, a bitstream representing an encoded user interface;

broadcasting said encoded user interface;

receiving said encoded user interface; and

decoding and displaying said user interface.

9. The method of claim 8 wherein said generating step further comprises the steps of:

producing a video signal representing a user interface;

encoding said video signal to produce said bitstream; and

modulating said bitstream into a format for transmission.

10. The method of claim 9 wherein the video signal is a composite of a video image and a graphics image.

11. The method of claim 9 further comprising the step of assigning a bitstream identifier value to said bitstream.

12. The method of claim 8 wherein said generating step further comprises the steps of:

producing a plurality of video signals representing a plurality of user interfaces;

encoding said video signals to produce a plurality of bitstreams; and

arranging said bitstreams into at least one transport stream; and

modulating said at least one transport stream into a format for transmission.

13. The method of claim 12 wherein said at least one transport stream comprises a system stream that contains a plurality of transport streams.

14. The method of claim 8 wherein the decoding step further comprises the steps of:

extracting a bitstream from a transport stream;

decoding the bitstream to produce a user interface.

15. The method of claim 14 wherein said extracting step further comprises the step of:

identifying said bitstream to be extracted by a bitstream identifier value.

16. The method of claim 8 further comprising the steps of:

selecting an object within the user interface;

sending a signal to the head end in response to the selection of the object; and

causing an event to occur within said head end in response to said signal.

17. The method of claim 16 wherein said event is one or more of tuning said subscriber equipment to an analog channel, tuning said subscriber equipment to a digital channel, causing a locally resident event to occur.

18. A method of generating and using an interactive user interface comprising the steps of:

generating, within a head end of an information distribution system, a transport stream that contains a plurality of bitstreams representing a plurality of encoded user interfaces;

broadcasting said transport stream;

receiving said transport stream;

extracting from said transport stream a select bitstream; and

decoding and displaying said select bitstream to produce said user interface.

19. The method of claim 18 further comprising the steps of:

selecting, in a first user interface, an object that identifies said select bitstream;

decoding said select bitstream without resetting a buffer in a decoder.

20. The method of claim 18 further comprising the steps of:

producing an overlay graphic for selectively emphasizing objects within said user interface.

21. The method of claim 20 further comprising the steps of:

selecting an emphasized object to change the context of the system from a user interface context.

22. The method of claim 21 wherein said context is changed to a pay per view movie context, a broadcast television context, a preview context or a sales context.

23. The method of claim 21 wherein changing the context causes the decoder to extract a different bitstream for decoding.

24. The method of claim 21 further comprising decoding an audio bitstream that is associated with a video region of said user interface.

25. The method of claim 24 wherein said audio is continuous through transitions to other user interfaces.

26. A method of generating and using an interactive user interface comprising the steps of:

encoding a user interface using slice based encoding to produce a plurality of bitstreams where each bitstream represents a different portion of the user interface;

generating, within a head end of an information distribution system, a transport stream that contains the plurality of bitstreams representing a slice based encoded user interface;

broadcasting said transport stream;

receiving said transport stream;

extracting from said transport stream a plurality of select bitstreams; and

decoding said select bitstreams to produce decoded portions of said user interface;

performing slice based splicing reassemble said user interface from said decoded portions.

27. The method of claim 26 wherein each bitstream is assigned a separate program identification value.

28. The method of claim 26 wherein each portion of said user interface contains different rates of motion.

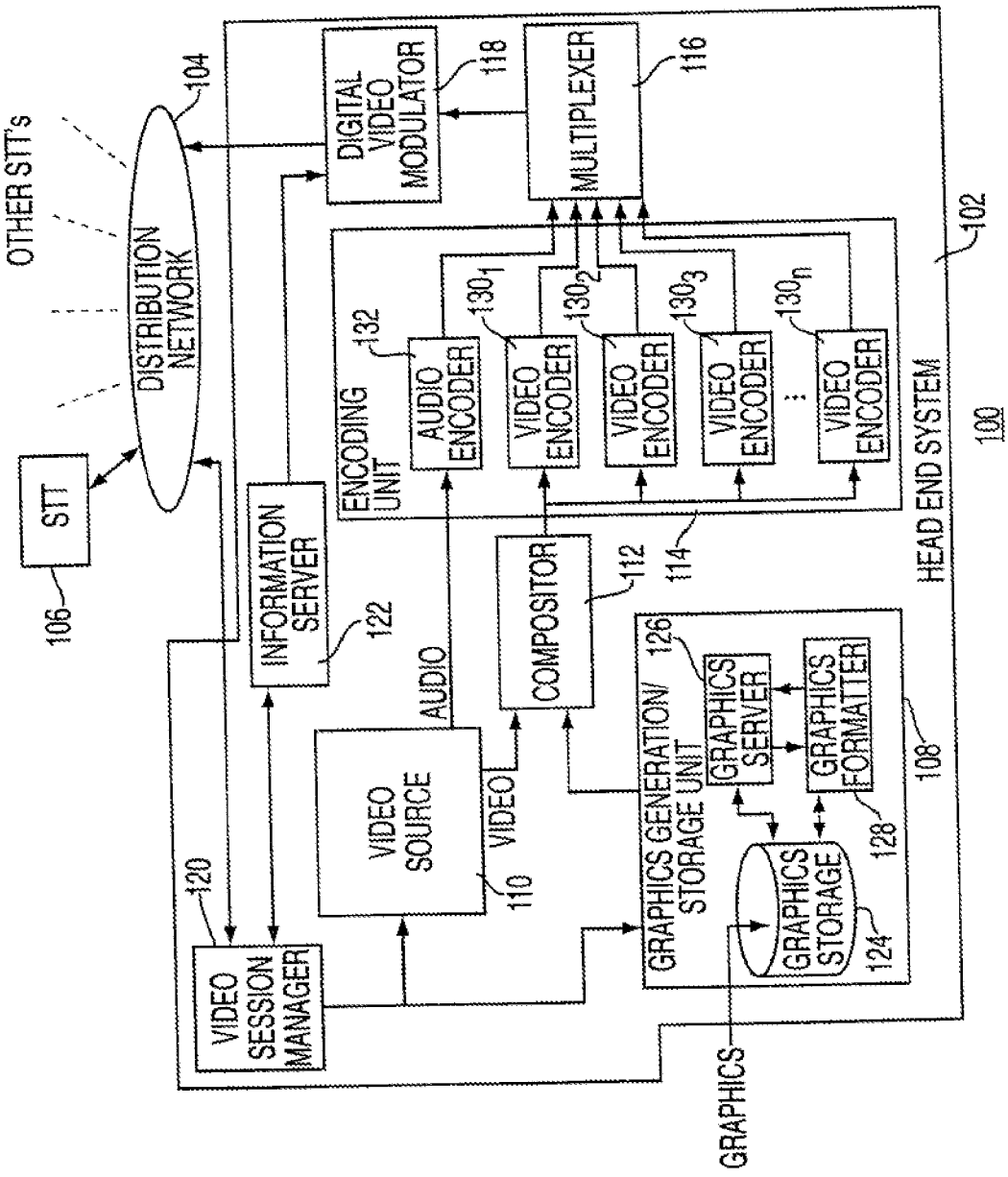
OTHER STT's
DISTRIBUTION NETWORK
104
STT
106
DIGITAL VIDEO MODULATOR
118
MULTIPLEXER
116
ENCODING UNIT
132
AUDIO ENCODER
$130_1$
VIDEO ENCODER
$130_2$
VIDEO ENCODER
$130_3$
VIDEO ENCODER
$130_n$
VIDEO ENCODER
HEAD END SYSTEM
100
102
INFORMATION SERVER
122
COMPOSITOR
112
114
AUDIO
VIDEO SOURCE
VIDEO
110
GRAPHICS GENERATION/ STORAGE UNIT
126
GRAPHICS SERVER
GRAPHICS FORMATTER
128
GRAPHICS STORAGE
124
108
VIDEO SESSION MANAGER
120
GRAPHICS

FIG. 1

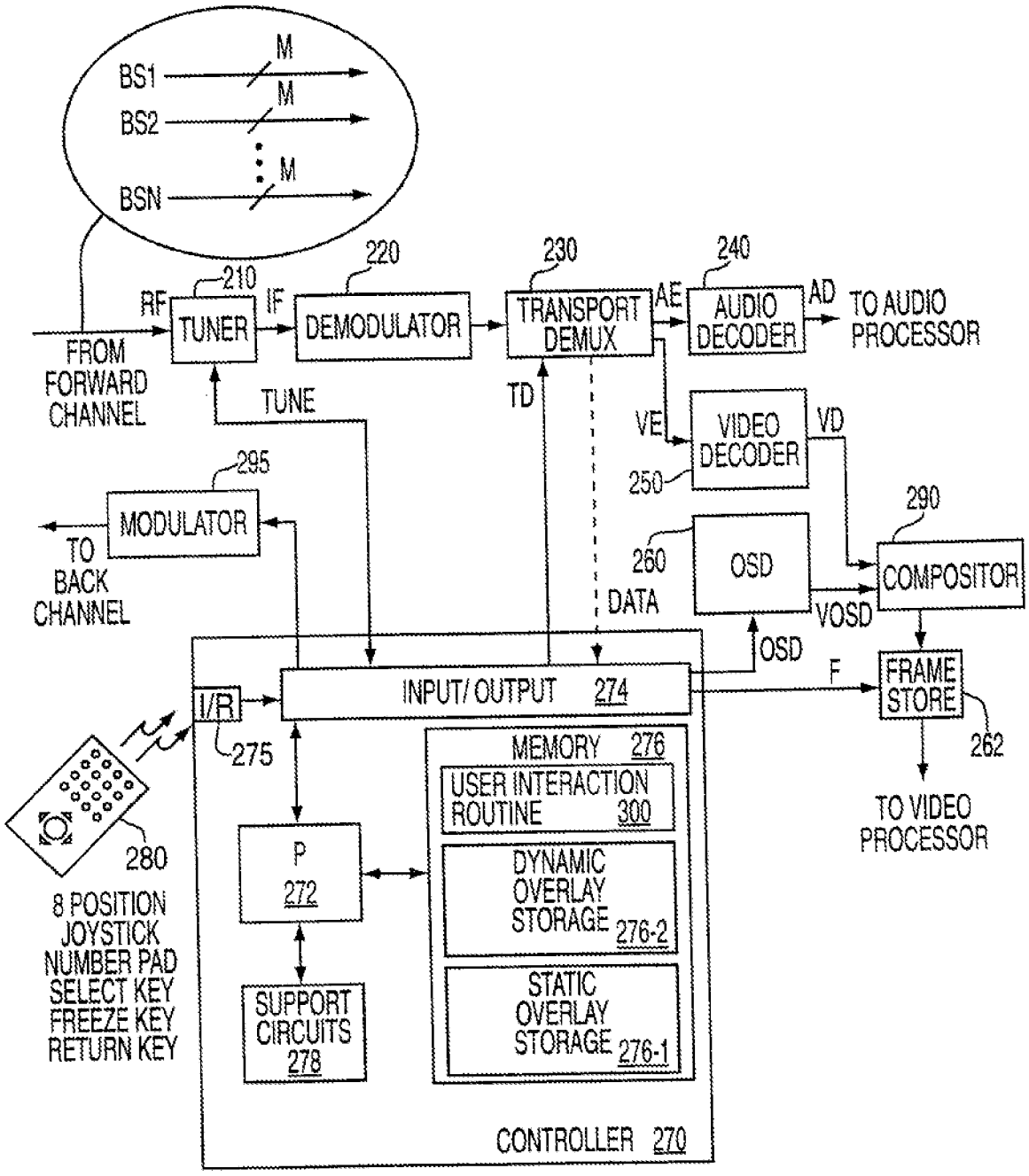
BS1
BS2
BSN
M
M
M
FROM FORWARD CHANNEL
RF
TUNER
210
IF
DEMODULATOR
220
TRANSPORT DEMUX
230
AE
AUDIO DECODER
240
AD
TO AUDIO PROCESSOR
TUNE
TD
VE
VIDEO DECODER
250
VD
MODULATOR
295
TO BACK CHANNEL
260
OSD
DATA
VOSD
COMPOSITOR
290
OSD
F
FRAME STORE
262
TO VIDEO PROCESSOR
I/R
275
INPUT/ OUTPUT 274
MEMORY 276
USER INTERACTION ROUTINE 300
DYNAMIC OVERLAY STORAGE 276-2
STATIC OVERLAY STORAGE 276-1
P 272
SUPPORT CIRCUITS 278
280
8 POSITION JOYSTICK
NUMBER PAD
SELECT KEY
FREEZE KEY
RETURN KEY
CONTROLLER 270

FIG. 2

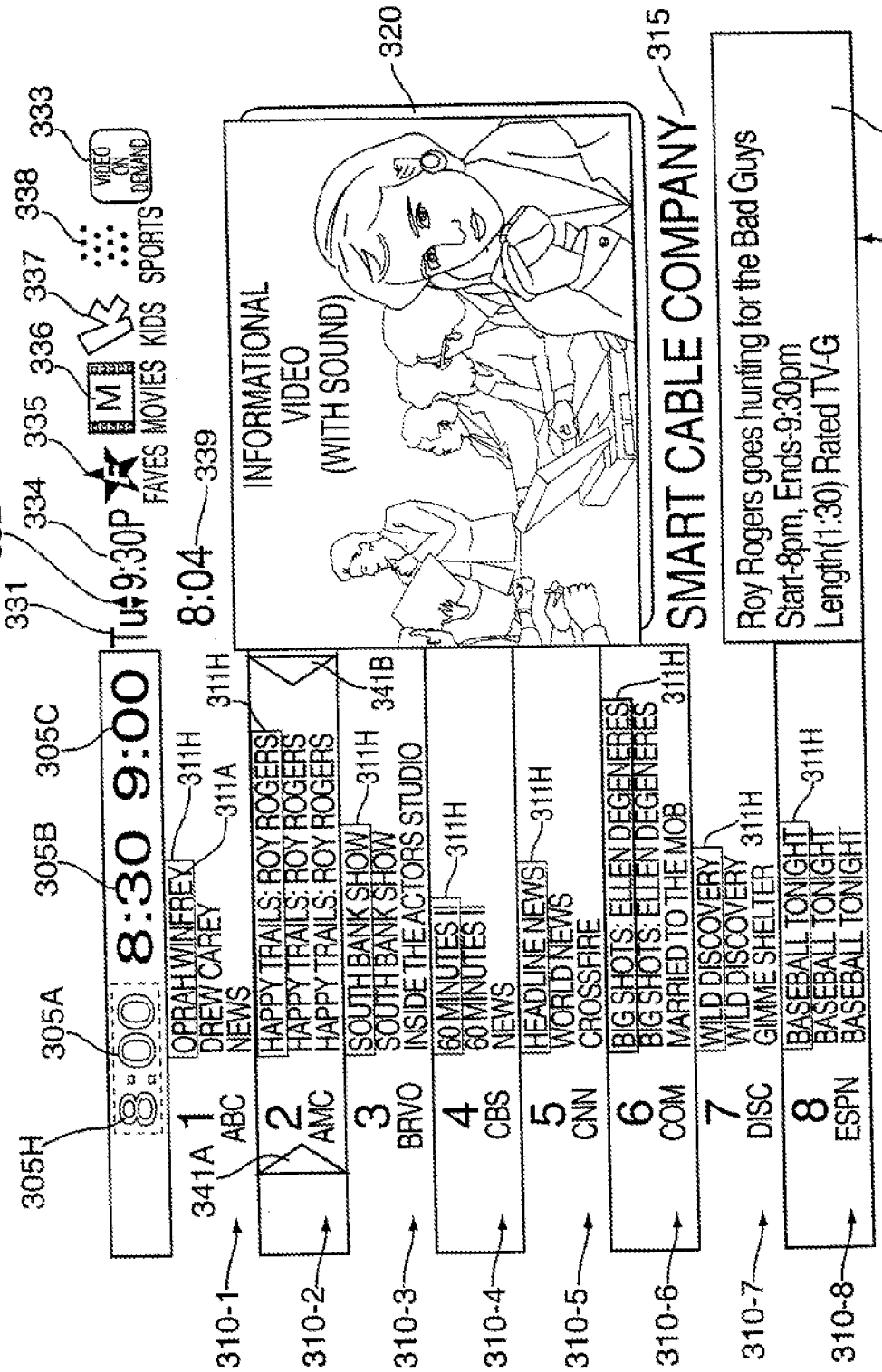
8:00 8:30 9:00
Tue 9:30P
8:04
FAVES MOVIES KIDS SPORTS
VIDEO ON DEMAND
INFORMATIONAL VIDEO (WITH SOUND)
SMART CABLE COMPANY
Roy Rogers goes hunting for the Bad Guys
Start-8pm, Ends-9:30pm
Length(1:30) Rated TV-G
1 ABC OPRAH WINFREY DREW CAREY NEWS
2 AMC HAPPY TRAILS: ROY ROGERS HAPPY TRAILS: ROY ROGERS HAPPY TRAILS: ROY ROGERS
3 BRVO SOUTH BANK SHOW SOUTH BANK SHOW INSIDE THE ACTORS STUDIO
4 CBS 60 MINUTES II 60 MINUTES II NEWS
5 CNN HEADLINE NEWS WORLD NEWS CROSSFIRE
6 COM BIG SHOTS: ELLEN DEGENERES BIG SHOTS: ELLEN DEGENERES MARRIED TO THE MOB
7 DISC WILD DISCOVERY WILD DISCOVERY GIMME SHELTER
8 ESPN BASEBALL TONIGHT BASEBALL TONIGHT BASEBALL TONIGHT
300A
302
304
305A
305B
305C
305H
310-1
310-2
310-3
310-4
310-5
310-6
310-7
310-8
311A
311H
315
320
331
332
333
334
335
336
337
338
339
341A
341B
350

FIG. 3A

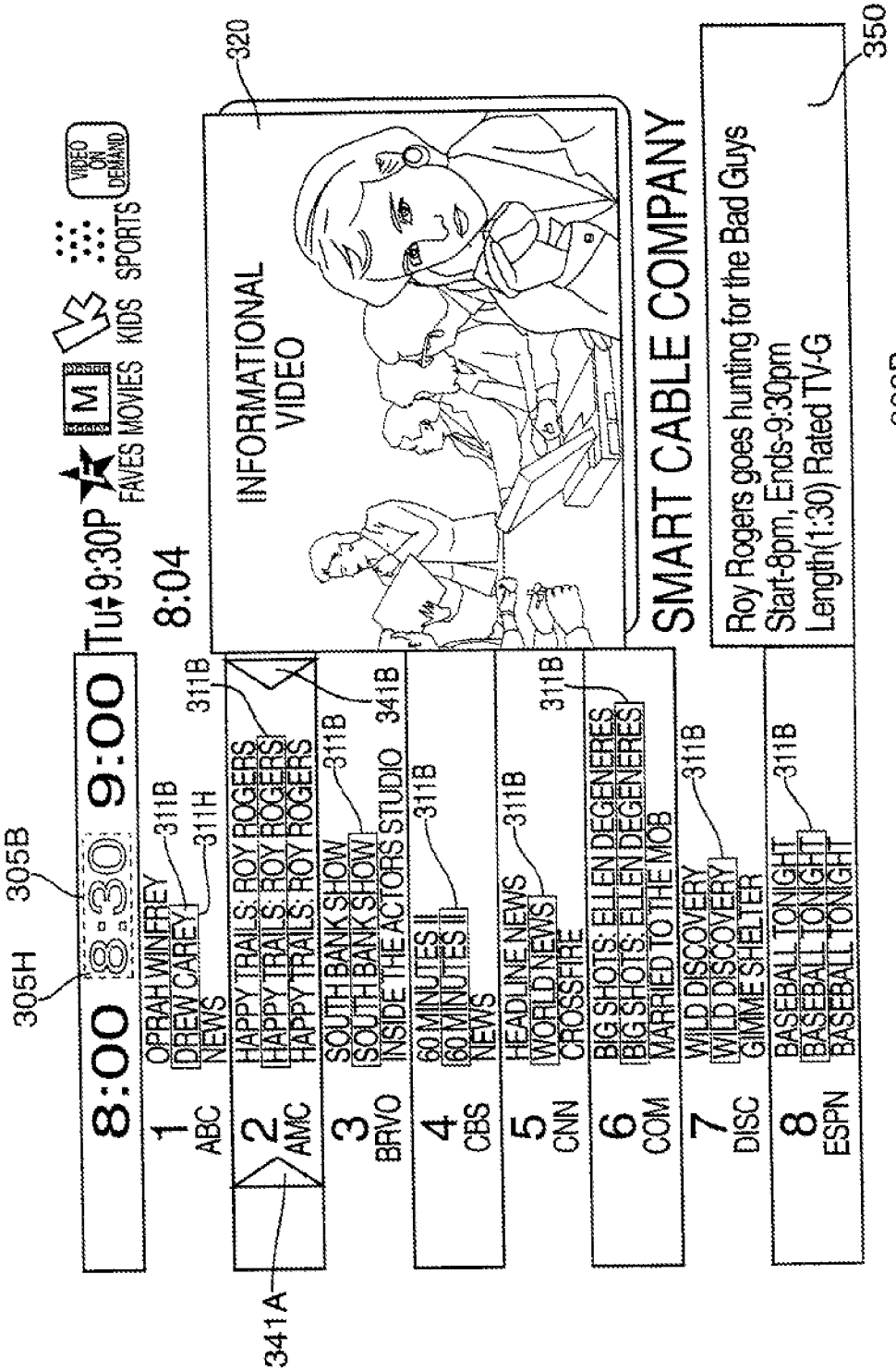
8:00
8:30
9:00
Tu 9:30P
8:04
FAVES
MOVIES
KIDS
SPORTS
VIDEO ON DEMAND
INFORMATIONAL VIDEO
SMART CABLE COMPANY
Roy Rogers goes hunting for the Bad Guys
Start-8pm, Ends-9:30pm
Length(1:30) Rated TV-G
1 ABC
OPRAH WINFREY
DREW CAREY
NEWS
2 AMC
HAPPY TRAILS: ROY ROGERS
HAPPY TRAILS: ROY ROGERS
HAPPY TRAILS: ROY ROGERS
3 BRVO
SOUTH BANK SHOW
SOUTH BANK SHOW
INSIDE THE ACTORS STUDIO
4 CBS
60 MINUTES II
60 MINUTES II
NEWS
5 CNN
HEADLINE NEWS
WORLD NEWS
CROSSFIRE
6 COM
BIG SHOTS: ELLEN DEGENERES
BIG SHOTS: ELLEN DEGENERES
MARRIED TO THE MOB
7 DISC
WILD DISCOVERY
WILD DISCOVERY
GIMME SHELTER
8 ESPN
BASEBALL TONIGHT
BASEBALL TONIGHT
BASEBALL TONIGHT
305H
305B
311B
311H
341A
341B
320
350
300B

FIG. 3B

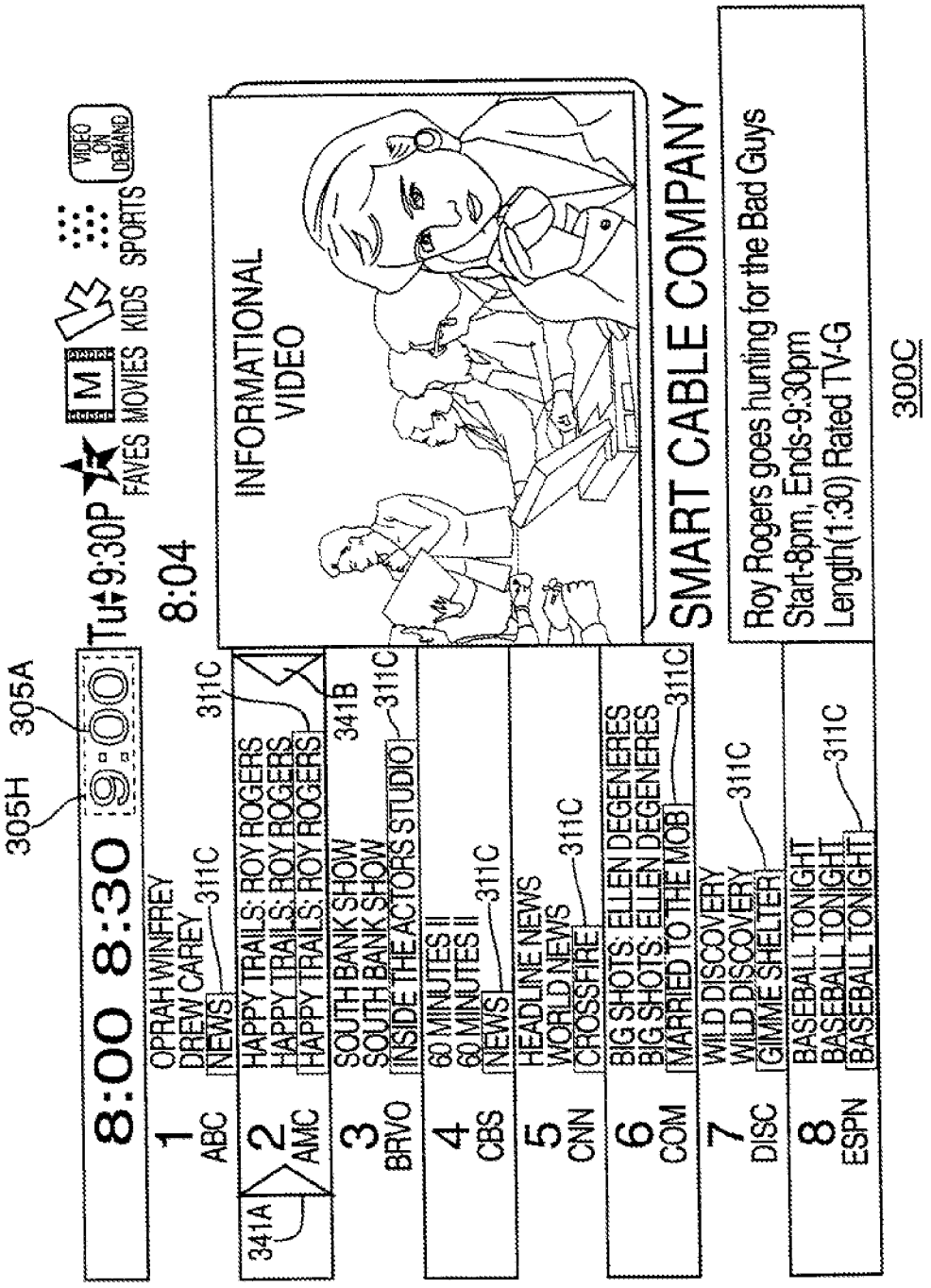
305H
305A
8:00 8:30 9:00 Tu 9:30P
FAVES
MOVIES
KIDS
SPORTS
VIDEO ON DEMAND
8:04
INFORMATIONAL VIDEO
SMART CABLE COMPANY
Roy Rogers goes hunting for the Bad Guys
Start-8pm, Ends-9:30pm
Length(1:30) Rated TV-G
300C
1 ABC
OPRAH WINFREY
DREW CAREY
NEWS
311C
2 AMC
341A
HAPPY TRAILS: ROY ROGERS
HAPPY TRAILS: ROY ROGERS
HAPPY TRAILS: ROY ROGERS
3 BRVO
SOUTH BANK SHOW
SOUTH BANK SHOW
INSIDE THE ACTORS STUDIO
341B
4 CBS
60 MINUTES II
60 MINUTES II
NEWS
5 CNN
HEADLINE NEWS
WORLD NEWS
CROSSFIRE
6 COM
BIG SHOTS: ELLEN DEGENERES
BIG SHOTS: ELLEN DEGENERES
MARRIED TO THE MOB
7 DISC
WILD DISCOVERY
WILD DISCOVERY
GIMME SHELTER
8 ESPN
BASEBALL TONIGHT
BASEBALL TONIGHT
BASEBALL TONIGHT

FIG. 3C

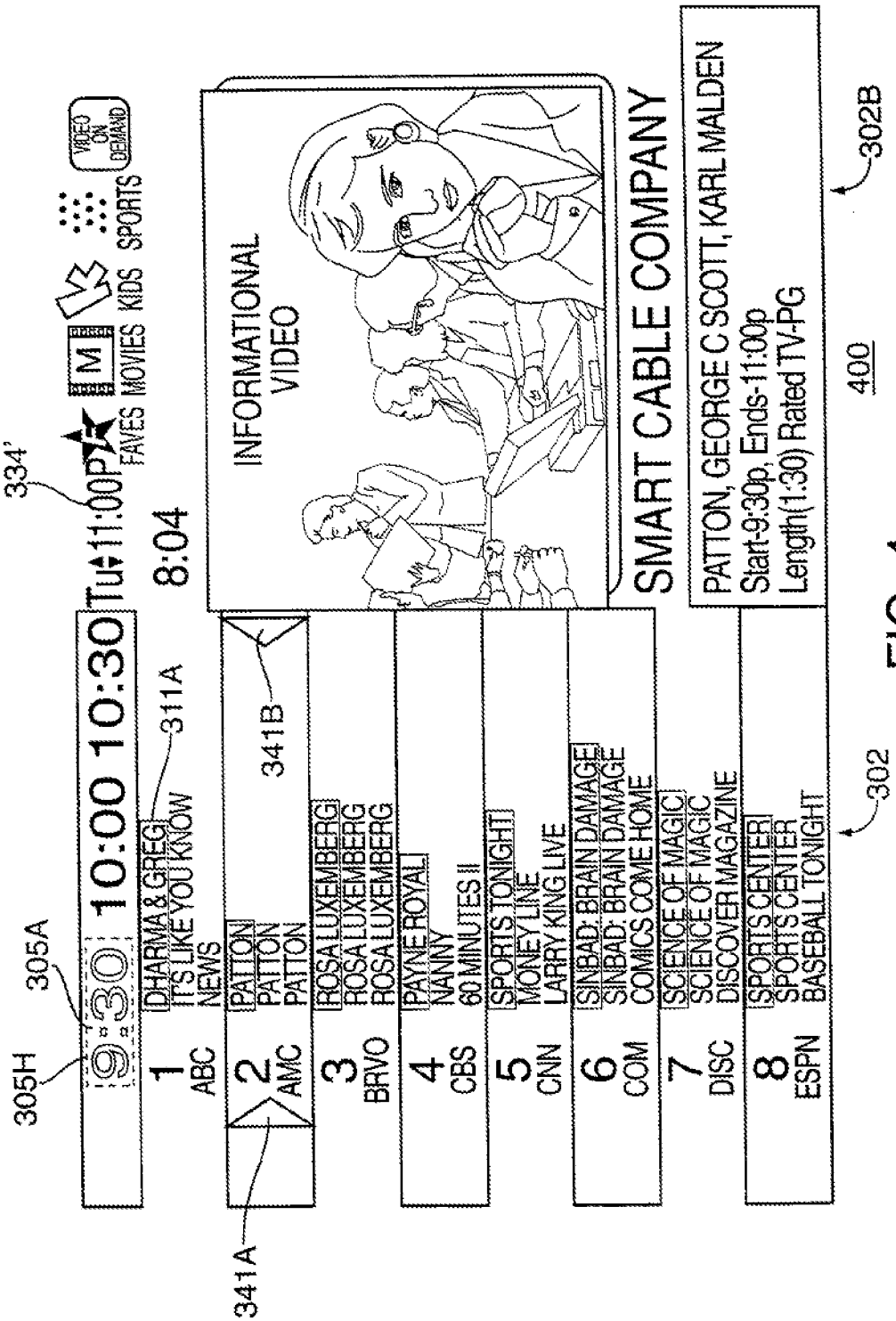
334'
FAVES
MOVIES
KIDS
SPORTS
VIDEO ON DEMAND
INFORMATIONAL VIDEO
SMART CABLE COMPANY
PATTON, GEORGE C SCOTT, KARL MALDEN
Start-9:30p, Ends-11:00p
Length(1:30) Rated TV-PG
302B
400
305H
9:30
10:00
10:30
Tu 11:00P
8:04
305A
311A
341B
341A
1 ABC DHARMA & GREG IT'S LIKE YOU KNOW NEWS
2 AMC PATTON PATTON PATTON
3 BRVO ROSA LUXEMBERG ROSA LUXEMBERG ROSA LUXEMBERG
4 CBS PAYNE ROYAL NANNY 60 MINUTES II
5 CNN SPORTS TONIGHT MONEY LINE LARRY KING LIVE
6 COM SINBAD: BRAIN DAMAGE SINBAD: BRAIN DAMAGE COMICS COME HOME
7 DISC SCIENCE OF MAGIC SCIENCE OF MAGIC DISCOVER MAGAZINE
8 ESPN SPORTS CENTER SPORTS CENTER BASEBALL TONIGHT
302

FIG. 4

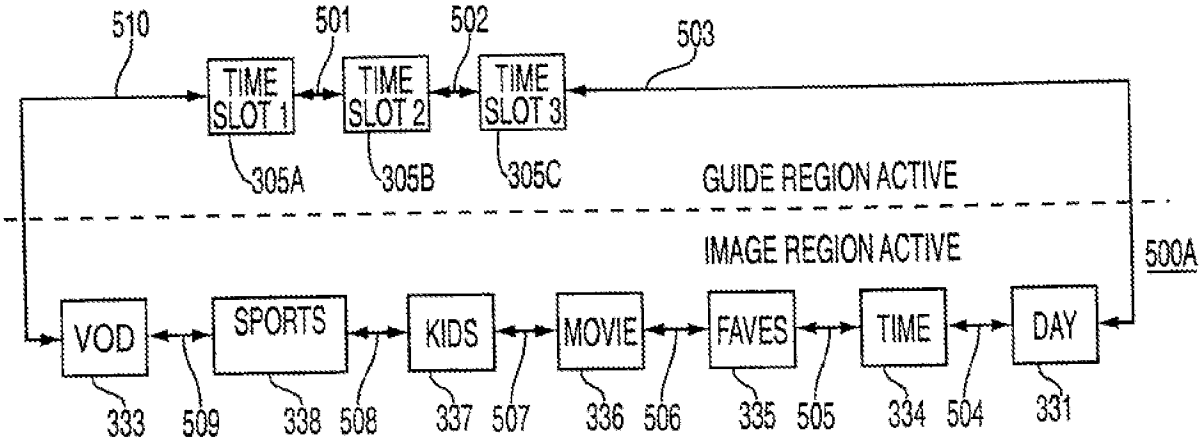


FIG. 5A

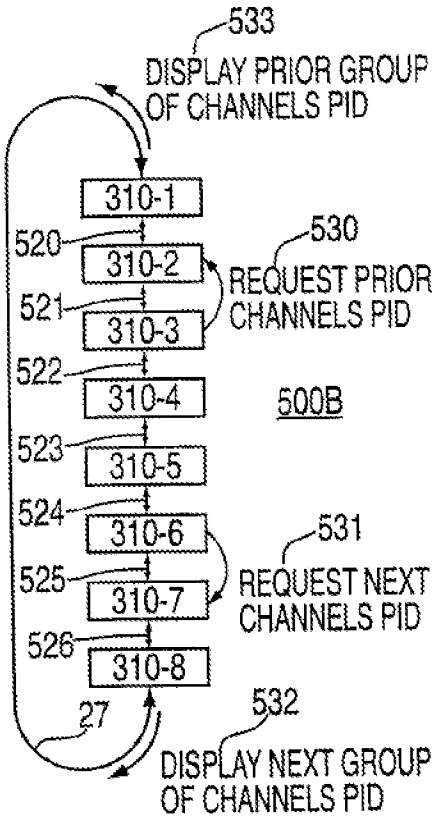


FIG. 5B

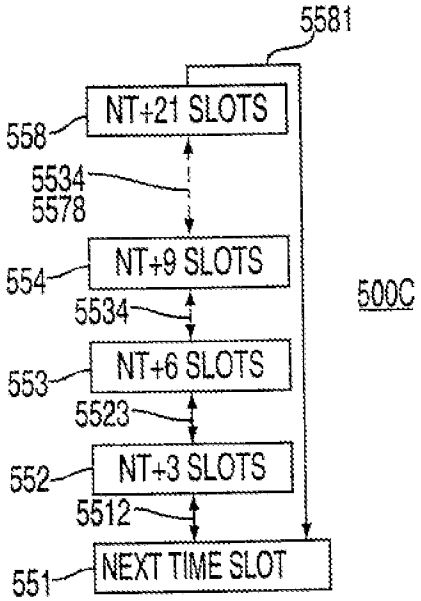


FIG. 5C

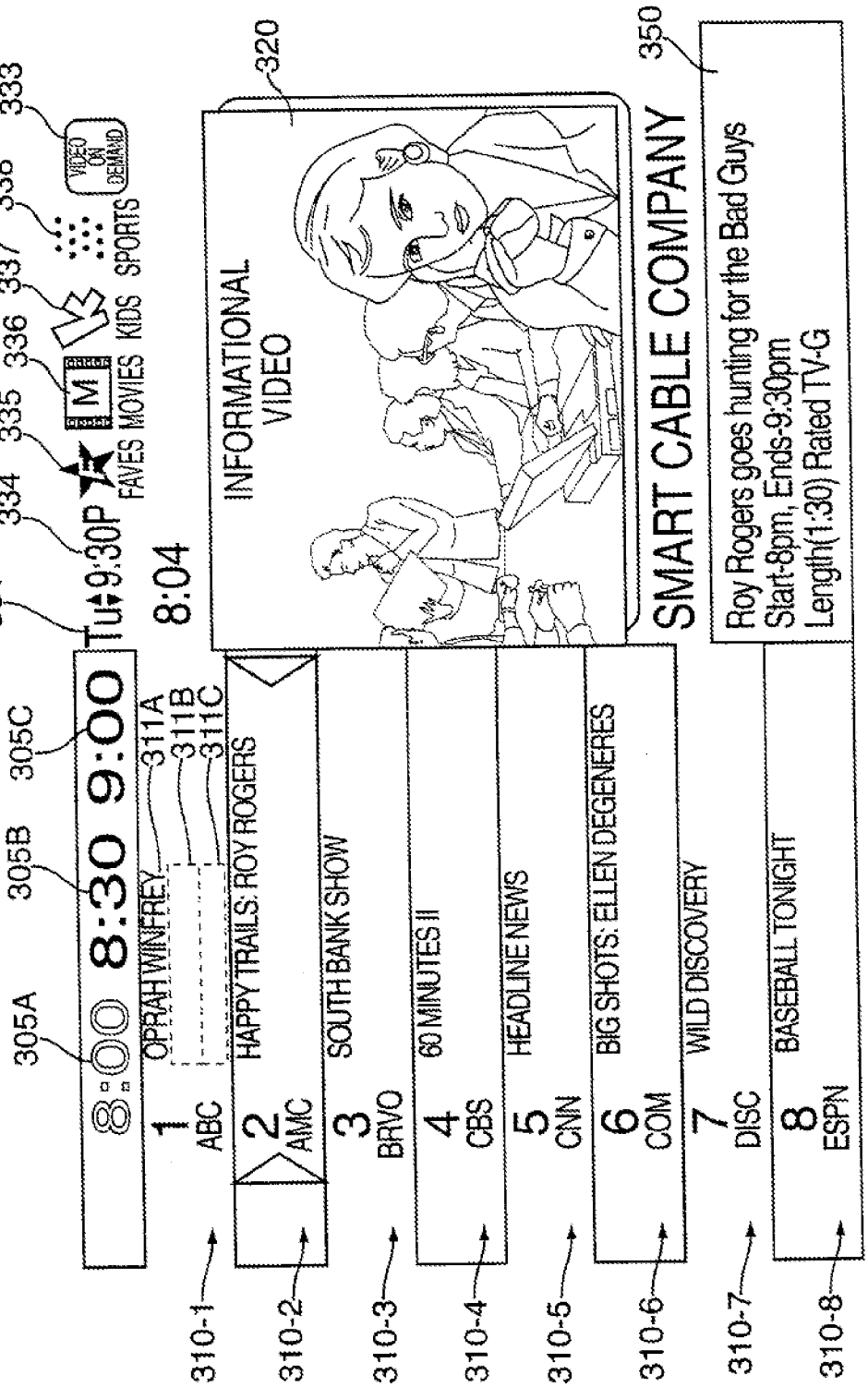
305A
305B
305C
331
334
335
336
337
338
333
320
350
8:00 8:30 9:00
Tu 9:30P
8:04
FAVES
MOVIES
KIDS
SPORTS
VIDEO ON DEMAND
INFORMATIONAL VIDEO
SMART CABLE COMPANY
Roy Rogers goes hunting for the Bad Guys
Start-8pm, Ends-9:30pm
Length(1:30) Rated TV-G
600A
311A
311B
311C
1 ABC OPRAH WINFREY
2 AMC HAPPY TRAILS: ROY ROGERS
3 BRVO SOUTH BANK SHOW
4 CBS 60 MINUTES II
5 CNN HEADLINE NEWS
6 COM BIG SHOTS: ELLEN DEGENERES
7 DISC WILD DISCOVERY
8 ESPN BASEBALL TONIGHT
310-1
310-2
310-3
310-4
310-5
310-6
310-7
310-8

FIG. 6A

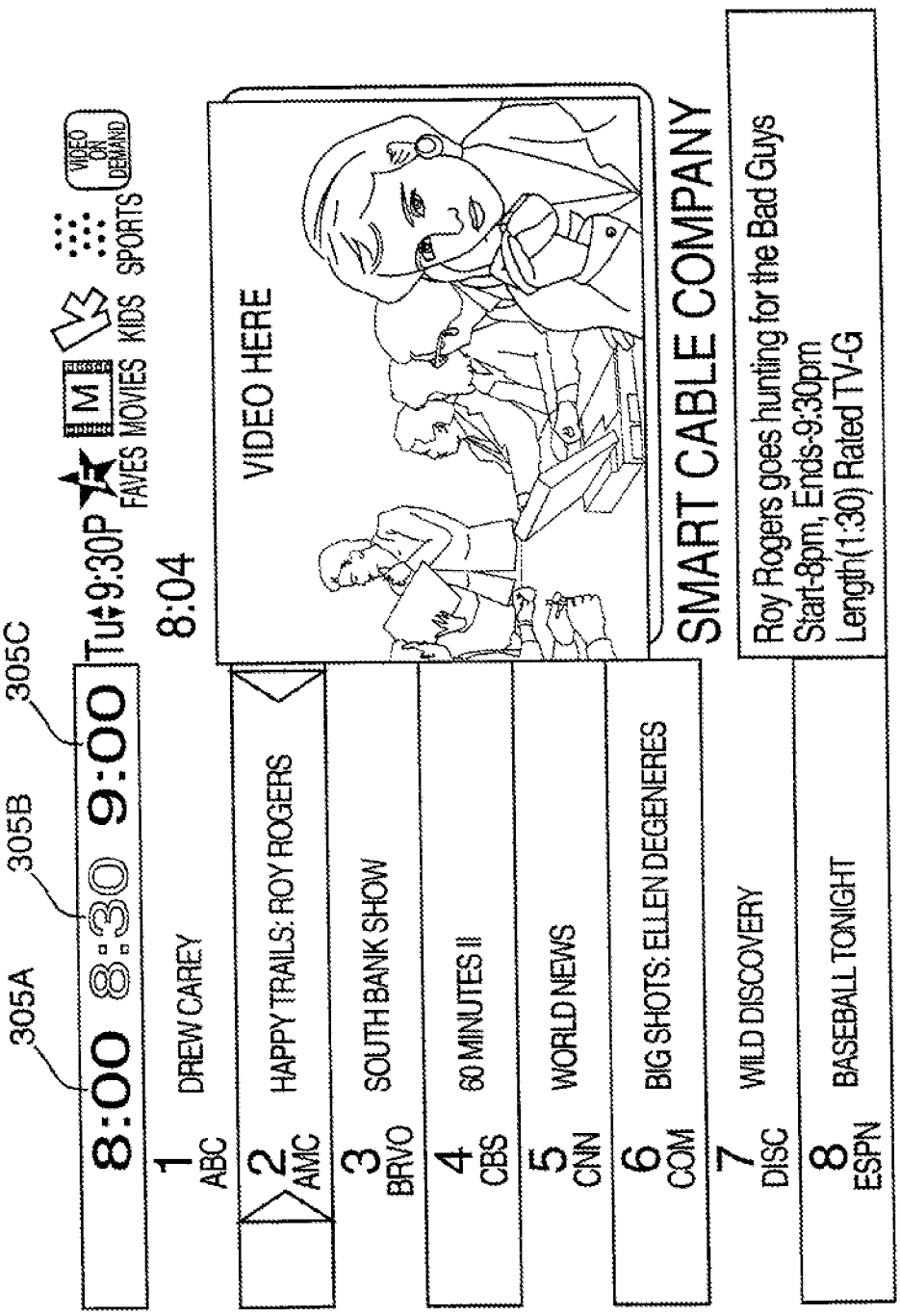
305A
305B
305C
8:00 8:30 9:00
Tu 9:30P
FAVES
MOVIES
KIDS
SPORTS
VIDEO ON DEMAND
8:04
VIDEO HERE
SMART CABLE COMPANY
Roy Rogers goes hunting for the Bad Guys
Start-8pm, Ends-9:30pm
Length(1:30) Rated TV-G
1 ABC DREW CAREY
2 AMC HAPPY TRAILS: ROY ROGERS
3 BRVO SOUTH BANK SHOW
4 CBS 60 MINUTES II
5 CNN WORLD NEWS
6 COM BIG SHOTS: ELLEN DEGENERES
7 DISC WILD DISCOVERY
8 ESPN BASEBALL TONIGHT
600B

FIG. 6B

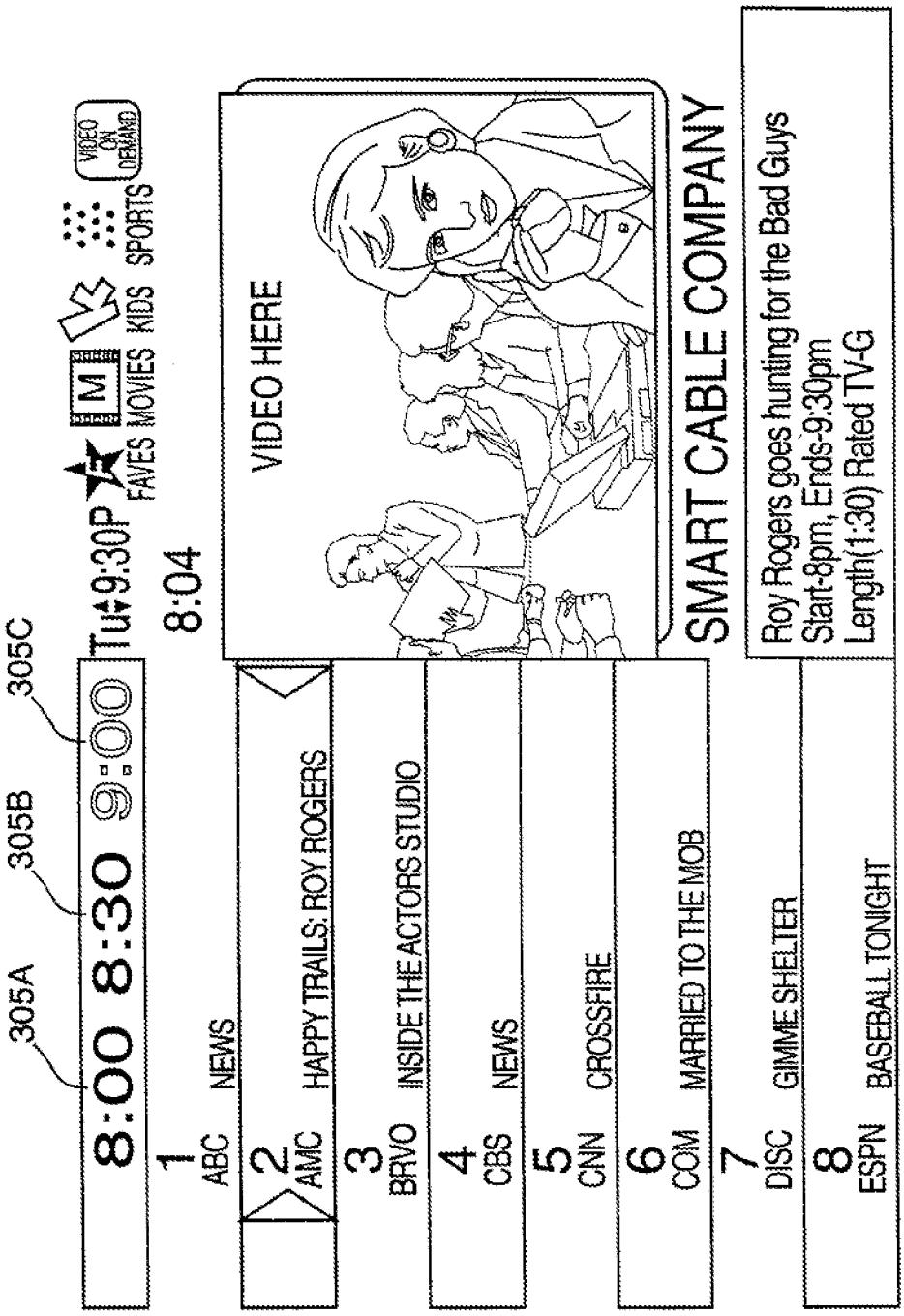
305A
305B
305C
8:00 8:30 9:00
Tu 9:30P
8:04
FAVES
MOVIES
KIDS
SPORTS
VIDEO ON DEMAND
VIDEO HERE
SMART CABLE COMPANY
Roy Rogers goes hunting for the Bad Guys
Start-8pm, Ends-9:30pm
Length(1:30) Rated TV-G
1 ABC NEWS
2 AMC HAPPY TRAILS: ROY ROGERS
3 BRVO INSIDE THE ACTORS STUDIO
4 CBS NEWS
5 CNN CROSSFIRE
6 COM MARRIED TO THE MOB
7 DISC GIMME SHELTER
8 ESPN BASEBALL TONIGHT
600C

FIG. 6C

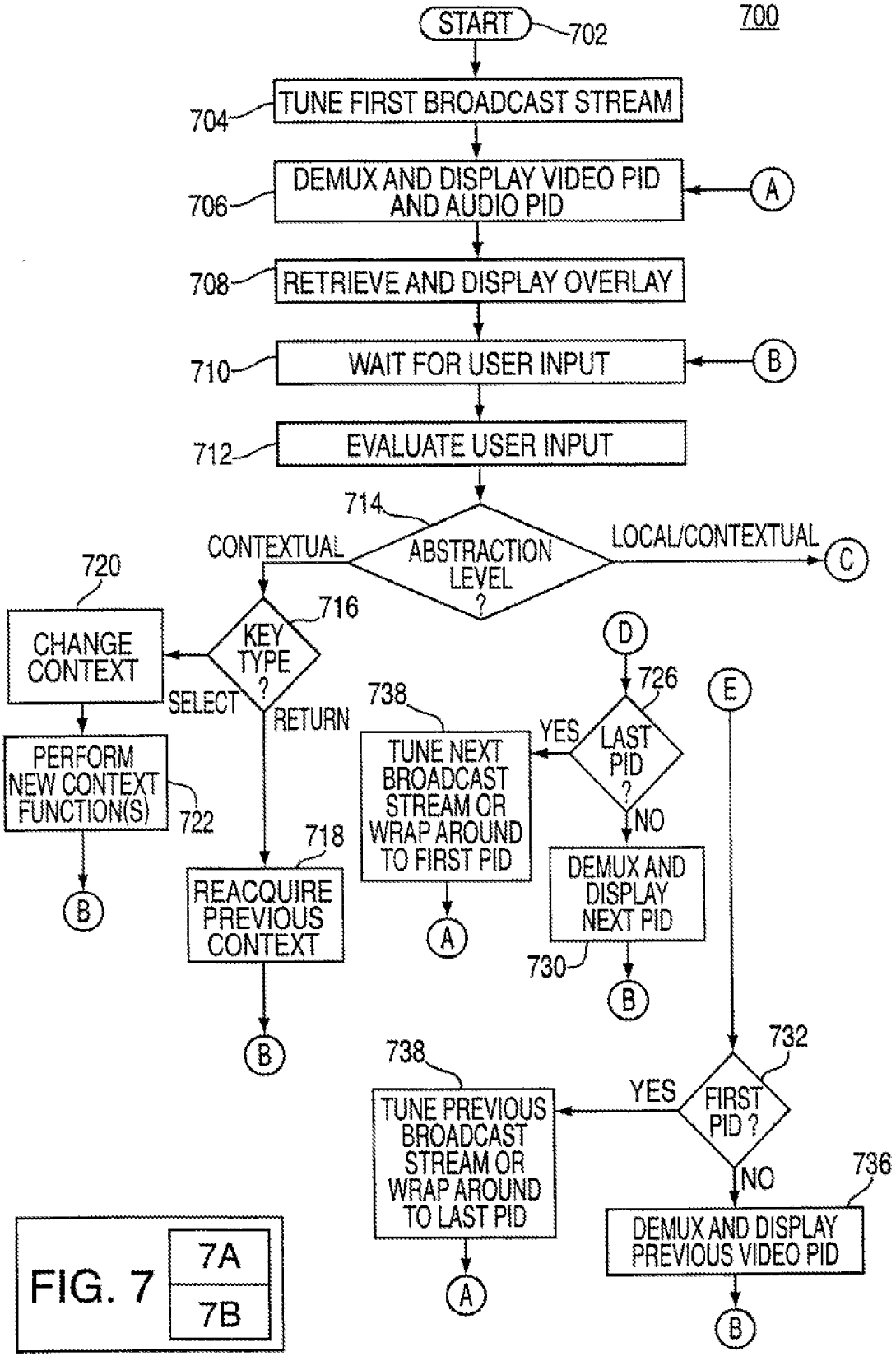
700
START
702
TUNE FIRST BROADCAST STREAM
704
DEMUX AND DISPLAY VIDEO PID AND AUDIO PID
706
A
RETRIEVE AND DISPLAY OVERLAY
708
WAIT FOR USER INPUT
710
B
EVALUATE USER INPUT
712
714
ABSTRACTION LEVEL ?
CONTEXTUAL
LOCAL/CONTEXTUAL
C
720
CHANGE CONTEXT
716
KEY TYPE ?
SELECT
RETURN
PERFORM NEW CONTEXT FUNCTION(S)
722
B
718
REACQUIRE PREVIOUS CONTEXT
B
D
726
LAST PID ?
YES
NO
738
TUNE NEXT BROADCAST STREAM OR WRAP AROUND TO FIRST PID
A
DEMUX AND DISPLAY NEXT PID
730
B
E
732
FIRST PID ?
YES
NO
738
TUNE PREVIOUS BROADCAST STREAM OR WRAP AROUND TO LAST PID
A
736
DEMUX AND DISPLAY PREVIOUS VIDEO PID
B

FIG. 7 (7A / 7B)

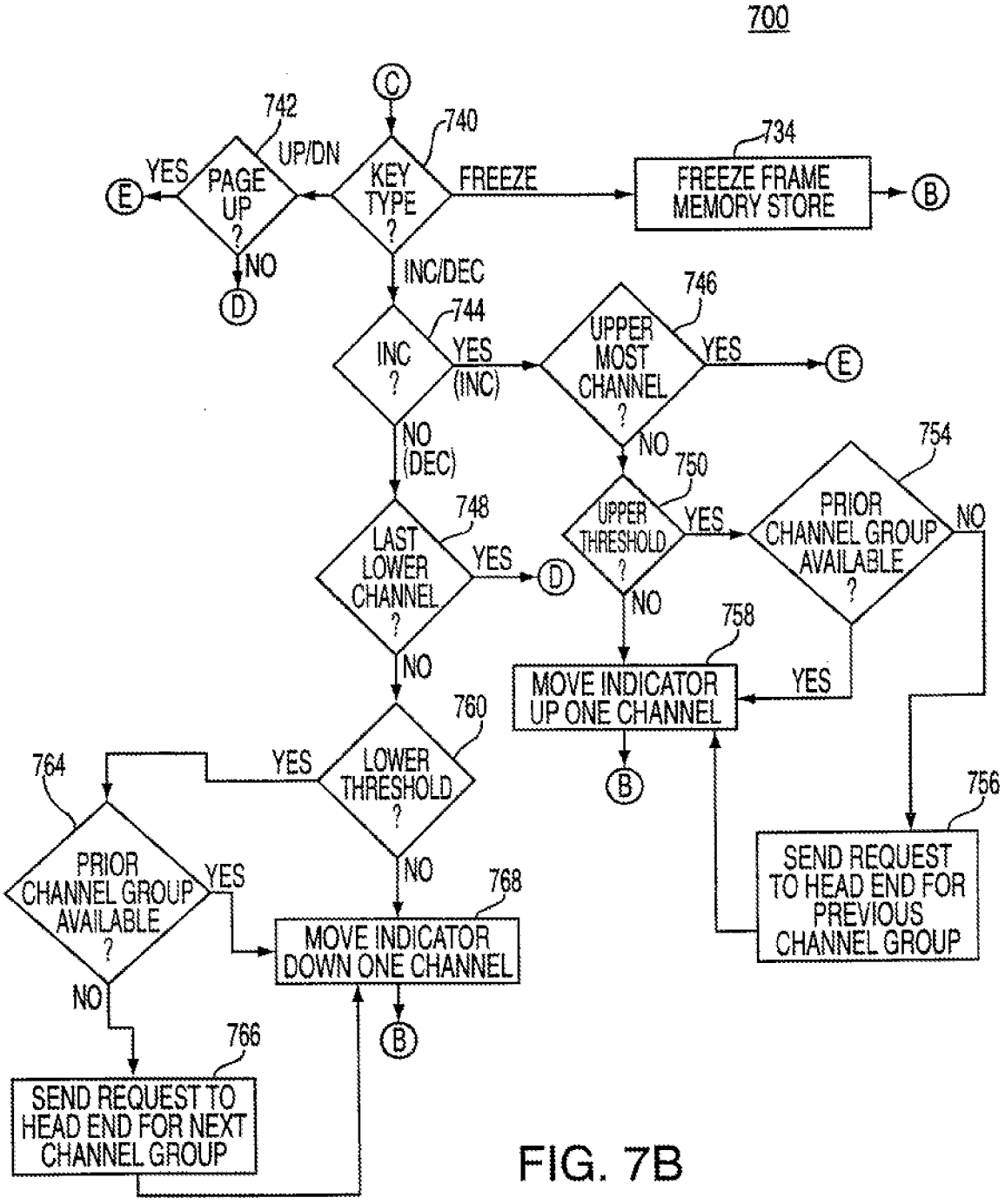
700
C
742
740
734
YES
PAGE UP ?
UP/DN
KEY TYPE ?
FREEZE
FREEZE FRAME MEMORY STORE
E
B
NO
D
INC/DEC
744
746
INC ?
YES (INC)
UPPER MOST CHANNEL ?
YES
E
NO (DEC)
NO
754
750
748
UPPER THRESHOLD ?
YES
PRIOR CHANNEL GROUP AVAILABLE ?
NO
LAST LOWER CHANNEL ?
YES
D
NO
758
MOVE INDICATOR UP ONE CHANNEL
YES
NO
760
B
764
YES
LOWER THRESHOLD ?
756
PRIOR CHANNEL GROUP AVAILABLE ?
YES
NO
768
SEND REQUEST TO HEAD END FOR PREVIOUS CHANNEL GROUP
MOVE INDICATOR DOWN ONE CHANNEL
NO
B
766
SEND REQUEST TO HEAD END FOR NEXT CHANNEL GROUP

FIG. 7B

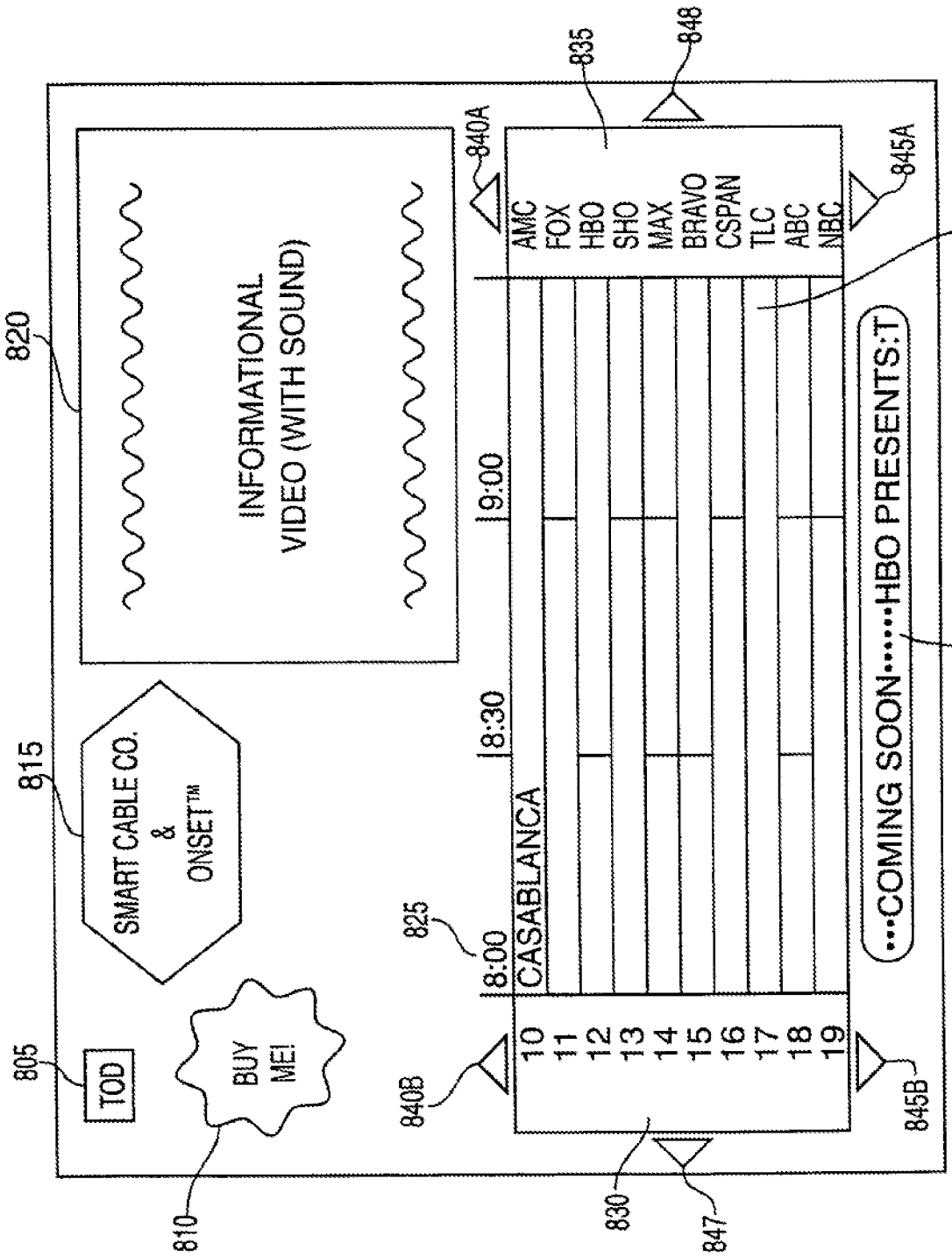
820
INFORMATIONAL
VIDEO (WITH SOUND)
815
SMART CABLE CO.
&
ONSET™
805
TOD
BUY
ME!
810
825
8:00
8:30
9:00
CASABLANCA
10
11
12
13
14
15
16
17
18
19
840B
830
847
835
848
840A
AMC
FOX
HBO
SHO
MAX
BRAVO
CSPAN
TLC
ABC
NBC
845A
850
...COMING SOON.....HBO PRESENTS:T
855
845B
800

FIG. 8

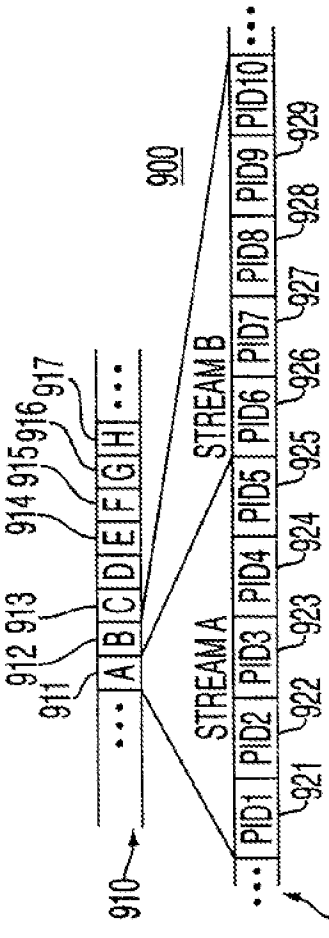
900
910
911
912
913
914
915
916
917
A
B
C
D
E
F
G
H
STREAM A
STREAM B
PID1
PID2
PID3
PID4
PID5
PID6
PID7
PID8
PID9
PID10
920
921
922
923
924
925
926
927
928
929

FIG. 9

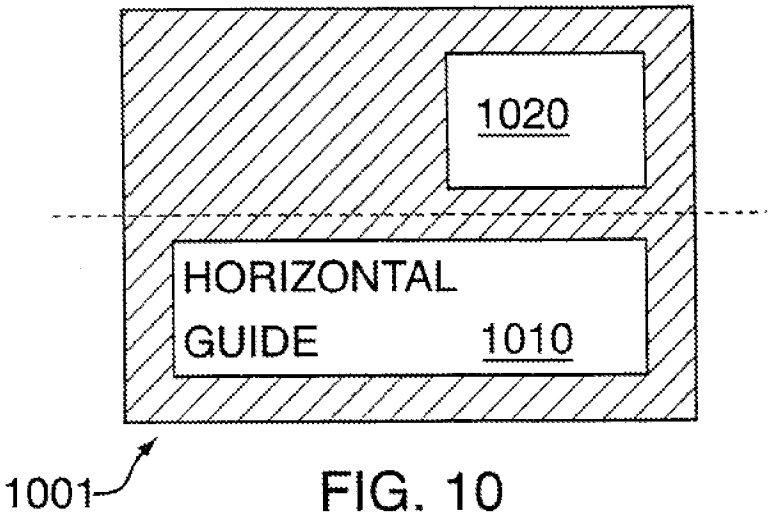
1020
HORIZONTAL
GUIDE
1010
1001

FIG. 10

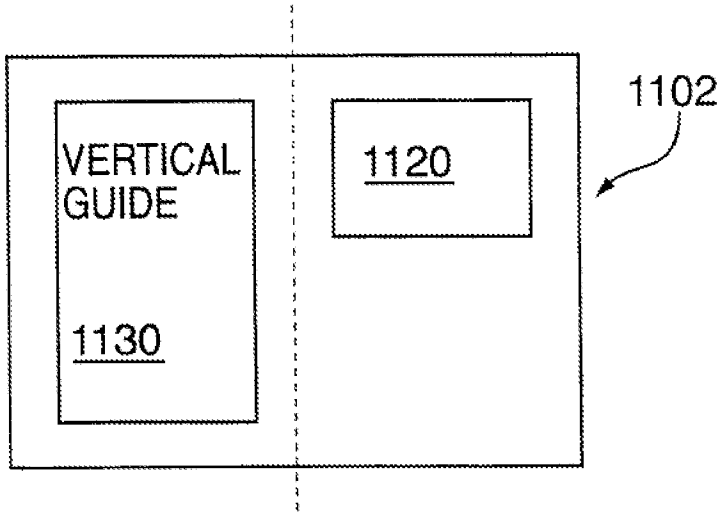
1102
VERTICAL
GUIDE
1130
1120

FIG. 11

| KEY | GUIDE REGION ACTION | IMAGE REGION ACTION |
|---|---|---|
| ↑ (INC) | INDICATE NEXT CHANNEL OR LAST CHANNEL OF PRIOR CHANNEL PID | VIEW NEXT TIME SLOTS POSSIBLY ENTER POINTCAST MODE |
| ↓ (DEC) | INDICATE PRIOR CHANNEL OR FIRST CHANNEL OF NEXT CHANNEL PID | VIEW PRIOR TIME SLOTS OR ENTER TIME SHIFT MODE |
| ⇑ (PAGE UP) | INDICATE CHANNEL IN PRIOR CHANNEL PID (CORRESPONDING, FIRST, LAST OR DEFAULT) | VIEW NEXT DAY POSSIBLY ENTER TIME SHIFT MODE |
| ⇓ (PAGE DN) | INDICATE CHANNEL IN NEXT CHANNEL PID (CORRESPONDING, FIRST, LAST OR DEFAULT) | VIEW PRIOR DAY POSSIBLY ENTER TIME SHIFT MODE |
| → MOVE RIGHT | EMPHASIZE NEXT TIME SLOT OR FIRST IMAGE REGION OBJECT | SELECT NEXT OBJECT |
| ← MOVE LEFT | EMPHASIZE PRIOR TIME SLOT OR LAST IMAGE REGION OBJECT | SELECT PRIOR OBJECT |
| SELECT | TUNE PRESENTLY INDICATED CHANNEL | SELECT HIGHLIGHTED OBJECT OR ENTER NEW OPERATING MODE |
| ADD/REMOVE | ADD/REMOVE INDICATED TITLE IN HIGHLIGHTED TIME SLOT TO FAVORITES | N/A |

FIG. 12

# INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/US 99/16786

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N7/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | WO 94 14282 A (DISCOVERY COMMUNICAT INC) 23 June 1994 (1994-06-23) page 12, line 23 -page 21, line 2 page 22, line 6 -page 25, line 20 page 26, line 17 -page 28, line 30 page 50, line 26 -page 56, line 5 page 91, line 1 -page 95, line 20 figures 1-30 | 1-28 |
| A | EP 0 838 958 A (THOMSON CONSUMER ELECTRONICS) 29 April 1998 (1998-04-29) page 3, column 3, line 50 -page 5, column 8, line 47 figures 1-7 | 1-28 |

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 12 October 1999 | 18/10/1999 |

| Name and mailing address of the ISA | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,<br>Fax: (+31-70) 340-3016 | Van der Zaal, R |

1

# INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte onal Application No
PCT/US 99/16786

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# GB2364195

Publication Title:

Method and apparatus for compressing video sequences

Abstract:

Abstract of GB 2364195

(A) Translate this text A method and apparatus (fig. 1) for compressing a plurality of video sequences (fig. 2, V1-V10) where each sequence (V1-V10) has information that is common with other sequences. The invention ensemble encodes (fig. 2, 220) the video sequences (fig. 2, V1-V10) into an MPEG compliant transport stream (fig. 1, E1-E10) using less predicted frame information than separately encoding each video sequence (fig. 2, V1-V10). One illustrative application of the invention is efficiently encoding (fig. 2, items 220) and transmitting (fig. 1, 104) a user interface such as a program guide (fig. 5, 560), navigator (fig. 5, 570) and the like. The user interface (fig. 5, 560) is illustratively embodied in an interactive programming guide (IPG).

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(31) 09384394 (32) 27.08.1999

(86) International Application Data
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(51) INT CL[7]
H04N 7/10 // H04N 7/14

(52) UK CL (Edition T )
H4F FBB FBBG FRX F22 F3P

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(58) Field of Search by ISA
US : 348/6, 7, 9, 10, 12, 13; 359/125, 133; 370/282

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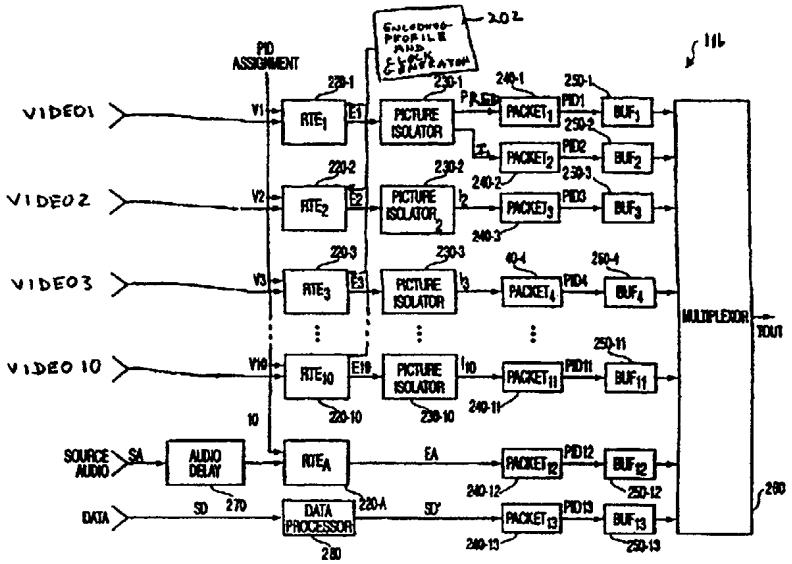
(74) continued overleaf

(54) Abstract Title
**Method and apparatus for compressing video sequences**

(57) A method and apparatus (fig. 1) for compressing a plurality of video sequences (fig. 2, V1-V10) where each sequence (V1-V10) has information that is common with other sequences. The invention ensemble encodes (fig. 2, 220) the video sequences (fig. 2, V1-V10) into an MPEG compliant transport stream (fig. 1, E1-E10) using less predicted frame information than separately encoding each video sequence (fig. 2, V1-V10). One illustrative application of the invention is efficiently encoding (fig. 2, items 220) and transmitting (fig. 1, 104) a user interface such as a program guide (fig. 5, 560), navigator (fig. 5, 570) and the like. The user interface (fig. 5, 560) is illustratively embodied in an interactive programming guide (IPG).




GB 2 364 195 A

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124,726

# PATENT SPECIFICATION

*Convention Date (France), May 24, 1917.*
*Application Date (in the United Kingdom), Mar. 14, 1919. No. 6449/19.*
*Complete Accepted, Dec. 18, 1919.*

COMPLETE SPECIFICATION.

## Improvements in or relating to Belt Fasteners.

I, ALEXIS VERNAZ, of 7, Quai Claude Bernard, Lyons, in the Republic of France, Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The present invention relates to the type of fasteners for transmission belts forming a hinge between the two assembled ends, and fixed to the belt by means of projections which are integral with the fasteners and which penetrate obliquely into the thickness of the material of the belt and more particularly to the kind of fasteners wherein the hinged connection between the parts is formed without the use of a pintle or hinge pin.

Now the object of this invention is to evolve an improved construction of the type of belt fastener referred to, and according to this improved construction the fastener comprises two members, one fixed to each end of the belt, a male member provided with tenons the widened heads of which together form the pintle or hinge pin and a female member provided with eyes or loops separated by intervals just wide enough to take the shanks of the tenons on the male member, while the wider heads of these tenons remain engaged inside the eyes or loops, the loops and tenons being formed by suitably stamping out slots in the blank plate and folding the plate on its transverse central line; the spaces between the loops on the female member being suitably widened, in order to enable the heads of the tenons on the male member or penetrate all together into the corresponding loops on the female member, this alignment being arranged in such a way that the tenons cannot be either engaged or withdrawn when the two parts of the belt are arranged parallel to or in line with one another, the teeth that serve to fix the fasteners to the belt being integral with the fasteners, and particularly disposed so that the holes made in the thickness of the material for the purpose of receiving the points, pass through the leather obliquely, and are far enough away from one another to eliminate weakening appreciably the belt.

The present applicant is aware that a belt fastener formed in two parts having interengaging members whereby a hinge pin is dispensed with has been described in the Specification of Patent No. 23,224 of 1899, and no claim is made to anything described and claimed in this specification.

The accompanying drawings illustrate my invention when constructing fasteners for use with leather belting. The numerous variations that may be conceived for the purpose of fulfilling the conditions specified above, either by

[*Price* 6*d.*]

modifying the shape of the loops and of the empty spaces that separate them, or by varying the outline, the length or the breadth of the heads or the shanks of the tenons, or even by arranging the teeth and the points differently, in various manners enabling the perforations made in the thickness of the leather to be spaced at will, all fall obviously within the domain of the present invention.

Figure 1 is a blank for male members.

Figure 2 is the corresponding blank for female members, with a different arrangement of the teeth and of their points.

Figure 3 is a preparatory blank from which it is possible to obtain at will either a male blank or a female blank by effecting the central cutting adapted to each.

Figure 4 is a section on 4—4 in Figure 1, in which the male fastener has been bent into its commercial form.

Figure 5 is the corresponding section of the male fastener, fixed on to the end of a belt.

Figure 6 is a section on 6—6 in Figure 2, showing the female fastener bent and brought into a commercial form.

Figure 7 is the section, corresponding to the preceding one, of the female fastener, placed on a belt with the mortises below.

Figure 8 indicates how the two ends of the belt are assembled or how they are disconnected.

Figure 9 is a view from above of the joint made with the fasteners of Figures 1 to 8.

In all these figures the same letters designate the same or similar parts.

In order to obtain the pair of fasteners illustrated in section in Figures 4 to 8 and in plan in Figure 9, the blank of the male members (Figure 1) and the blank of the female members (Figure 2) are first of all cut out of sheets of metal. The metal employed, especially for the manufacture of the male fasteners, should combine sufficient tenacity with great malleability, for it has to be able to resist the tension in the belt and to bear being bent on a block without cracking. As an example, mild steel or brass may be taken, in strips of suitable thickness, of indefinite length, and of a width a little greater than the distance between the larger opposite projections or teeth of the developed fasteners in a female section.

The cutting of the blank for the male members produces, at the edge, two sets of teeth of unequal length. The upper edge comprises the long teeth $a^1$ and the short teeth $c^1$, which alternate. The lower edge exhibits, also alternately, long teeth $a^2$ and short teeth $c^2$. The points of the teeth of one and the same border are equidistant, and the points of the teeth on one of the borders correspond to the intervals between the teeth on the other border. If it were desired at first only to cut the two borders, one would have the preparatory blank $e$ of Figure 3, with long teeth $a$ and short teeth $c$ and the two borders would be identical, since there would be nothing to distinguish then from one another when once this preparatory work was finished.

The longitudinal axis $n$, $n$ is determined, along which the fastener will ultimately have to be bent. The determination of this axis of bending must be effected with precision. For that purpose it is necessary to find the centre of a rectangle of which one side $p$ $q$ passes at equal distance from the points of the teeth $a$ and $c$ of one of the borders and of which the opposite side $r$ $s$ is in alignment with the points of the large teeth $a$ of the other border. This centre $t$ is marked with a punch, and the axis of bending must divide this punch mark into two equal parts. Then the axis of bending $n$—$n$ being determined in this way, the points of the teeth $a^1$ bent along line $b$, $b$ (Figure 1) will be the farthest from the tenon $g$ of the male fastener, (Figure 4); and the points of the teeth $a^2$, $c^1$ and $c^2$ will then come successively nearer to the tenon $g$. When the fastener is closed on to the belt, these points will describe

the four stepped arcs of circles shown dotted in Figure 4, and will engage the surface of the belt on four lines equally spaced in the direction of the length of the belt. The central aperture $k$, $k^1$, $k^2$ are then cut out, in the form of a double T (Figure 1), the narrower central part $k$ of which must be divided exactly into two equal parts by the axis of bending $n$, $n$. The parts $k^1$ and $k^2$ of these cavities extend equally on both sides of the central part $k$. These cavities are equally spaced and leave between them full parts $g$, $g^1$, $g^2$, the central region $g$ of which serves to form, by means of a bending on block, the heads of the tenons, while the regions $g^1$, $g^2$ form, upon being doubled over the shanks of the same tenons. The heights of the parts $k^1$ and $k^2$ of the central apertures are limited in such a way as to leave, along the toothed edges of the blank strips or bands of metal $h^1$ and $h^2$, of sufficient width to ensure a strong and rigid connection between the teeth of each border. Finally, to bring the male fastener into its commercial form, it is given the form shown in Figure 4, by straightening almost to a right angle the branches at the base of the tenons and by bending the teeth, inwards, at a distance from their points equal to about one and a half times the thickness of the belt, so as to form hooks, making, with the branches of the fastener, angles in the neighbourhood of half a right angle. The teeth are bent along $b$—$b$ and $d$—$d$.

If the extremity of the belt is engaged between the branches of the fastener thus prepared, and is pushed right home, it is possible, with a single blow of a hammer, to close the fastener, which takes naturally the form indicated in Figure 5, the points of the teeth entering obliquely into the thickness of the leather along four different lines at unequal distances from the heads of the tenons and at transverse distances which are sufficiently great to eliminate any appreciable weakening of the leather of the belt.

The teeth of the borders may be arranged in various ways and may take obliquely cut tooth shapes (Figures 1, 2 and 3), or they may be straight cut shapes. The teeth in the two borders may be in any order of succession, the order $a^1$, $a^2$, $c^1$, $c^2$, for example, (Figures 1 and 3), or the order $a^1$, $c^2$, $c^1$, $a^2$, similar to that shown in Figure 2 for the blank for the female fasteners.

The blank in Figure 2 is obtained in the same way, or by starting from the same preparatory blank (Figure 3), which would constitute a very obvious advantage as regards rapidity, regularity, precision and economy of manufacture. It differs only in the shape and not in the spacing of the central apertures so that when once the punching of the males is correctly adjusted all that is necessary is to change the punch, without fresh adjustment, in order to obtain females agreeing perfectly with the males of the same set. The female cavity is in the shape of a T the horizontal branch of which forms the mortise for the penetration of the male and the vertical branch the seating in which the shank of the tenon can oscillate. The mortise $m$ is a little wider and a little higher than the head $g$ of the tenon in its final form, so that in a suitable position this head can pass into and out of the mortise very easily. The seating $l$ of the shank of the tenon is a little wider than the tenon, which can oscillate therein without appreciable lateral friction. The full part remaining between two consecutive cavities $l$ forms, by bending along the line $n$—$n$, one of the loops of the hinge. These knuckles $f$, of strictly identical manufacture, are in accurate alignment after bending, and retain the heads $g$ of the tenons of the main member, which have been inserted through the mortises $m$. The teeth situated on the mortise side are the farthest from the line of bending $n$—$n$. The height of the T above and below the line $n$—$n$ is limited in such a way as to leave a supporting band $h^3$ or $h^4$ of sufficient breadth to connect the teeth of each border firmly together.

In order to complete the manufacture of the female fastener and put it into its commercial form, (Figure 6), all that is necessary is to bend the blank along the line $n$—$n$ so as to bring the branches to an angular distance of about 60°, then to bend the large teeth $a^4$, $a^3$ along the line $b$—$b$, and the small teeth $c^4$, $c^3$

along the line *d*—*d*, as was explained for the corresponding teeth of the male fastener. This fastener is fixed on to the belt B in the same manner as the male fastener was fixed on to the belt A, and then, in each mortise, the part $m^1$ of the leather, which partially obstructs the entrance (Figure 7), is removed with a chisel and a paring knife.

The two fasteners are then ready to assemble the two ends of the belt. For that purpose (Figure 8), the head of the tenon is inserted obliquely into the mortise, then the part A is rotated into alignment with the part B. The belt is then ready to be put on the pulley.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I declare is:—

1. A fastener for transmission belts of the type referred to comprising two members, one fixed to each end of the belt, a male member provided with tenons, the widened heads of which together form the pintle or hinge pin and a female member provided with eyes or loops separated by intervals just wide enough to take the shanks of the tenons on the male member, while the wider heads of these tenons remain engaged inside the eyes or loops, the loops and tenons being formed by suitably stamping out slots in the blank plate and folding the plate on its transverse central line, the spaces between the loops on the female member being suitably widened in order to enable the heads of the tenons on the male member to penetrate all together into the corresponding loops on the female member, this alignment being arranged in such a way that the tenons cannot be either engaged or withdrawn when the two parts of the belts are arranged parallel to or in line with one another, the teeth that serve to fix the fasteners to the belt being integral with the fasteners, and particularly disposed so that the holes made in the thickness of the material for the purpose of receiving the points, pass through the leather obliquely and are far enough away from one another to eliminate weakening appreciably the belt.

2. In a fastener as claimed in Claim 1, the provision of long and short teeth alternatively disposed along each edge of the fastener and adapted to engage the belt substantially as described with reference to the accompanying drawings.

3. A fastener for transmission belts, substantially as described with reference to the accompanying drawings.

Dated this 14th day of March, 1919.

HASELTINE, LAKE & Co.,
28, Southampton Buildings, London, England, and
55, Liberty Street, New York City, U.S.A.,
Agents for the Applicant.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1919.

FIG. 1

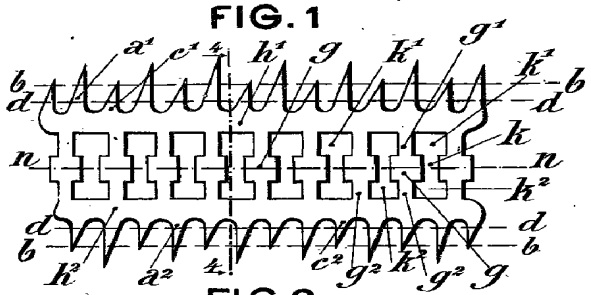


FIG. 2

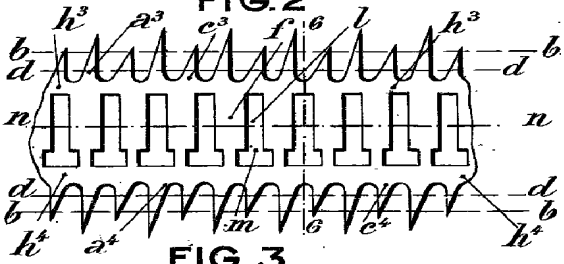


FIG. 3

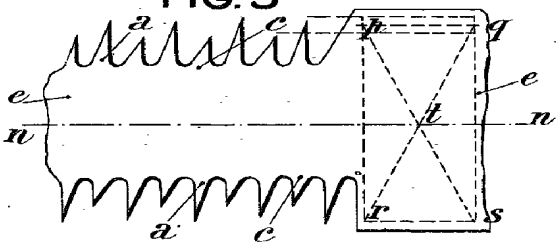


FIG. 4

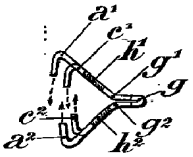


FIG. 5

FIG. 6

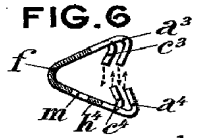


FIG. 7

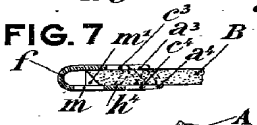


FIG. 8

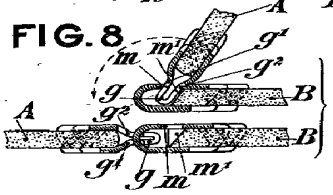


FIG. 9.

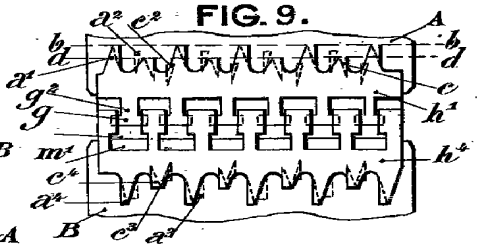


FIG. 1

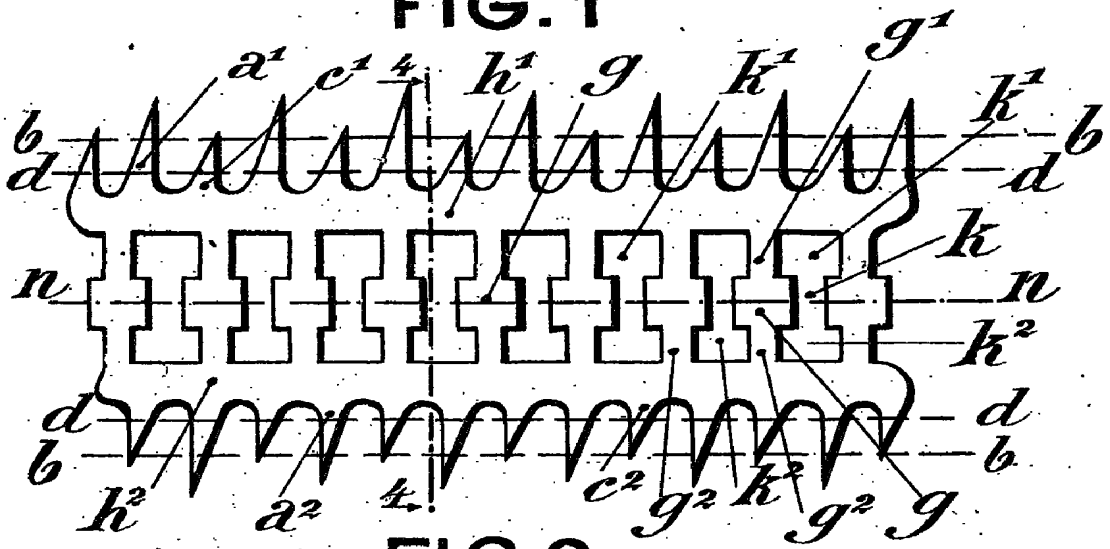



FIG. 2

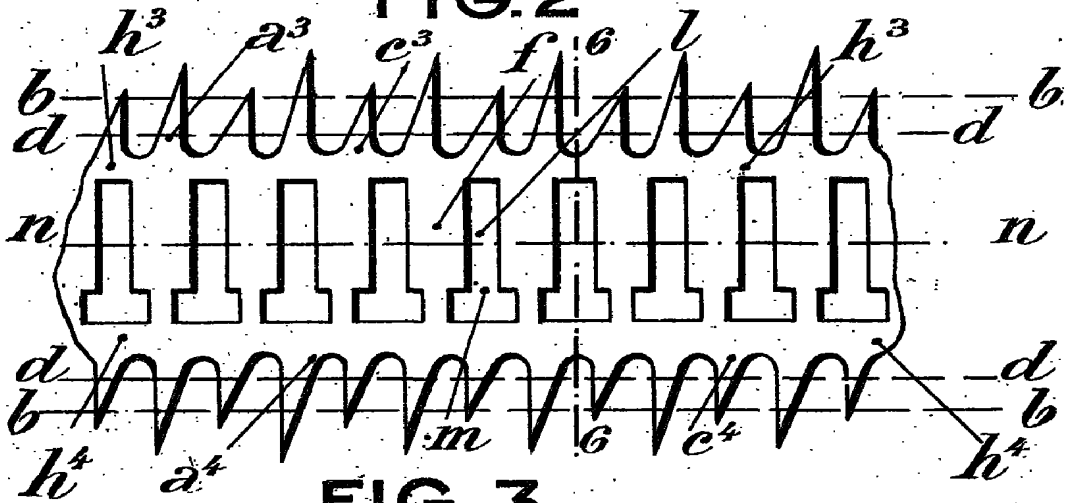
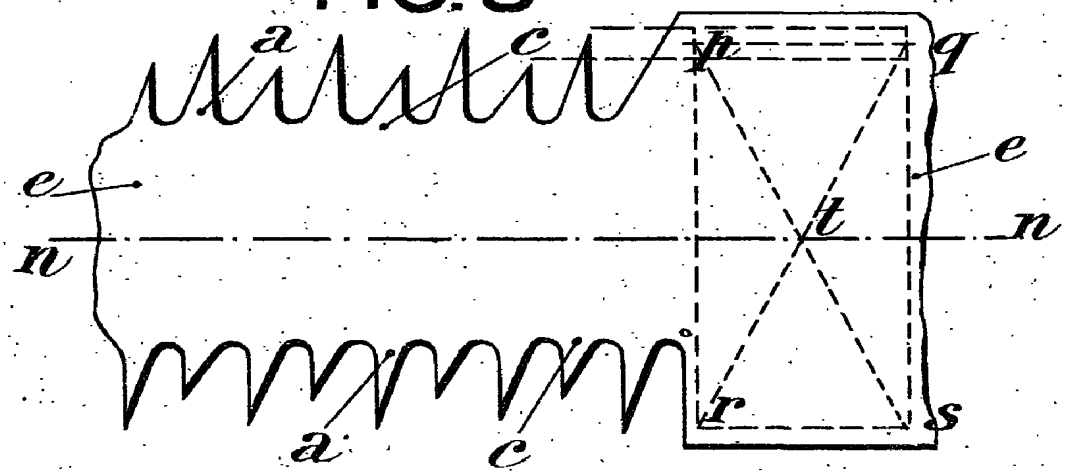
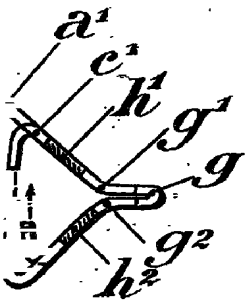



FIG. 3



IG. 4

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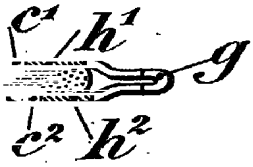


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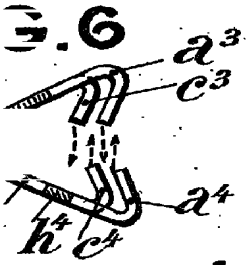


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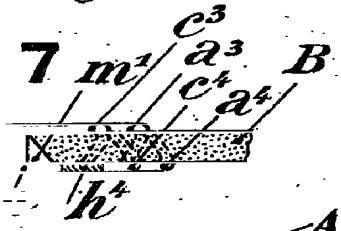


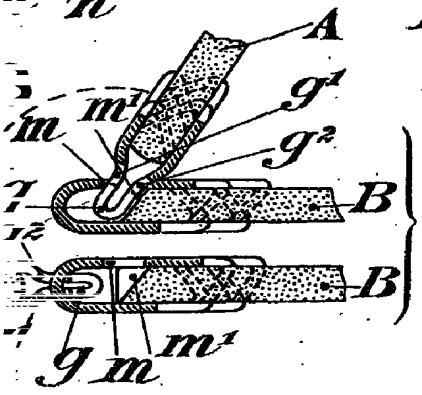
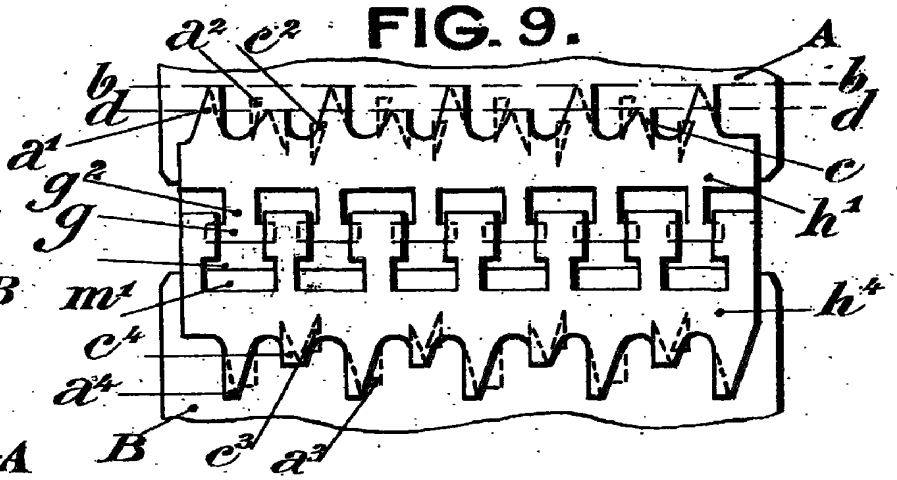




FIG. 9.



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Abstract:

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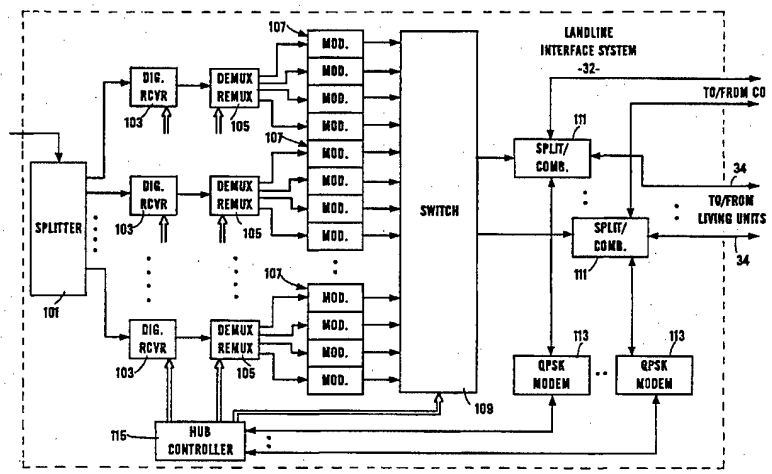


(57) Abstract

A broadcast system supplies multiplexed channels to a plurality of receiving systems. At least one of the receiving systems serves a plurality of living units (75). The common equipment includes a digital receiver (103) processing each multiplexer channel to capture a digital transport stream therefrom and a demultiplexer (105) for separating out the digital signals. A switch (109) routes selected information signals to individual drops or loops going to the living units (75). In one implementation, each digital signal is modulated, and selected modulated signals are routed and transported over telephone wiring to terminals (100) in the living units (75). The terminals (100) demodulate and decode selected program signals for presentation on a television. In a second implementation, a decoder in the common equipment decodes each digital signal, and the common equipment transmits an analog TV channel carrying decoded signals for selected programs over coaxial cables to the living units (75).

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# SHARED USE VIDEO PROCESSING SYSTEMS

## Cross-Reference to Related Application

This application is a continuation in part of U.S. Patent application Serial No. 08/441,977 filed May 16, 1995 entitled "SHARED RECEIVING SYSTEMS UTILIZING TELEPHONE CABLES AS VIDEO DROPS" (attorney docket no. 680-130B), the disclosure of which is incorporated herein in its entirety by reference.

## Technical Field

The present invention relates to distribution of program information, e.g. video, audio and data, particularly to shared receiving systems serving multiple living units. More specifically, the present invention relates to shared receiving systems processing broadcast digitally multiplexed program signals (preferably from a wireless simulcast system) to derive a signal for each program and supplying the signal for a selected program over on-premises wiring to each individual living unit.

## Background Art

In the 1960s, Community Antenna Television (CATV) was chartered to provide off-air television signals to viewers in broadcast reception fringe areas. Later, under FCC regulation, the CATV industry was required to provide local access and original programming in addition to off-air broadcast signal distribution. Because of the wide bandwidth available on cable television systems, additional channels were available for the new programming. To increase revenues, cable television systems initiated distribution of premium channels viewable only by subscribers having appropriate

descramblers. The subscriber tunes the descrambler to receive a premium channel, descramble the video and audio information and supply a signal capable of reception on a standard television set.

Recently, several different wideband digital distribution networks have been proposed for offering subscribers an array of video services, including true Video On Demand service. The following U.S. Patents disclose representative examples of such digital video distributions networks: 5,253,275 to Yurt et al., 5,132,992 to Yurt et al., 5,133,079 to Ballantyne et al., 5,130,792 to Tindell et al., 5,057,932 to Lang, 4,963,995 to Lang, 4,949,187 to Cohen, 5,027,400 to Baji et al., and 4,506,387 to Walter. In particular, Litteral et al. Patent No. 5,247,347 discloses a digital video distribution network providing subscribers with access to multiple Video On Demand service providers through the public switched telephone network, as described in more detail below.

Although the digital landline systems provide some enhanced services, such as video on demand, implementation and deployment to provide service to actual customers has remained limited because of a number of technical and economic problems. To develop and deploy fiber optical systems for providing wide bandwidth to carry a large number of services into every living unit is expensive. Also, community regulations in many areas now require placement of new cabling underground. Some property owners will not agree to allow utility companies to dig up their property to lay the new cables, and even where the owner permits such an installation, the underground installation of fiber and/or coaxial drop cables from fiber backbone circuits only further increases the expense and difficulty of deployment.

The use of public switched telephone network wiring suggested by Litteral et al. reduces the need to install

new fiber or cable, but the system disclosed therein is severely limited in terms of its service capability. As disclosed, direct cross connect switching provides point-to-point connectivity to the subscriber lines for interactive services, particularly video on demand. There is some limited point-to-multipoint capability, but not enough to cost effectively provide an array of broadcast type services competitive with current offerings through franchise based analog cable television systems.

Thus, a need still exists to provide a cost effective way to supply new digital broadband services to living units where it is not cost effective to deploy new fiber and cable to service those units.

Wireless video distribution is subject to much lower installation costs. However, as discussed below, wireless systems intended to compete with franchise cable services also have been subject to a number of problems and limitations.

"Wireless cable" is a term usually used to refer to a multi-channel video distribution medium that resembles franchise cable television, but which uses microwave channels rather than coaxial cable or wire to transmit programming to subscribers. Programming for wireless cable systems is received at the headend of the wireless cable system in the same manner as it is for landline based cable television. These programs are then re-transmitted, utilizing the high end of the Ultra High Frequency (UHF) portion of the microwave radio frequency spectrum (2.1 to 2.7 Ghz), by a microwave transmitting antenna located on a tower or other tall structure to small antennas on subscriber rooftops, typically within a 40 mile radius.

In a typical prior art system, such as shown in Figure 1, a headend system H receives up to a maximum of 33 analog television program signals from a variety of

satellite down-link receivers and other types of receivers, in the exact same manner as for a cable television system. The headend system H frequency multiplexes those television program signals into a combined spectrum signal in the 50-450 Mhz range. This combined signal has a frequency distribution similar to that found on a cable television network. The headend system upconverts the combined spectrum signal to the UHF frequency range, typically centered around 2.6 Ghz. The headend system supplies the UHF signal to a single transmitter antenna tower T which broadcasts the signal to subscribers who each have an individual home receiving system. Subscribers can call in to the headend to order pay-per-view events via the telephone network, and the headend transmits codes to the subscribers systems to enable descrambling of encoded pay-per-view programs.

Figure 1A shows a typical service area for a wireless cable type system of the type shown in Figure 1. In accord with relevant regulations, a multi-channel multi-point distribution service (MMDS) type wireless cable operator has a protected or 'primary' reception area P. At the relevant frequencies here under consideration, the primary area P is a circle having a radius of 15 miles from the operator's transmitter T. Within this area, the operator is guaranteed that there will be no interference with his transmissions on the assigned frequency channel(s). However, at the allowable power levels, the transmissions from antenna tower T will propagate out over a secondary area S having a radius of up to 40 miles. Within the secondary area, some locations will receive sufficient signal strength to utilize the wireless cable services.

UHF signals in the relevant frequency band arrive at a receiver location by direct line-of-sight (LOS) transmission. Typically an elliptical dish shaped antenna 18-36 inches long, formed of parallel curved

elements, is aimed from the subscriber location to receive the strongest signal from the transmitter. The captured signals are down-converted at the antenna from the microwave band to the broadcast band and transmitted via coaxial wiring into the house. For scrambled signals (the typical case), a set top converter functionally similar to a cable set top box is used. In many UHF installations, to conserve UHF capacity for premium services, a VHF/UHF off-air broadcast receive antenna is installed with the UHF antenna to pick up the local programming.

To a user or subscriber, wireless cable operates as a cable look-alike service. Because wireless cable signals are transmitted over the air rather than through underground or above-ground cable networks, wireless systems are less susceptible to outages and are less expensive to operate and maintain than franchise cable systems. Most service problems experienced by wireless cable subscribers are home-specific rather than neighborhood-wide, as is frequently the case with franchise cable systems.

The evolution of wireless cable, leading to certain problems, may be briefly summarized as follows. Wireless cable technology has existed in a single channel version for commercial purposes since the 1970's and had been available even longer for educational use. In mid-1983, the FCC, invoking the need to promote competition with conventional cable television systems, established a change in the rules for using a portion of the microwave spectrum previously designated for educational use. In the past, 28 microwave channels had been available to accredited and non-profit educational organizations for educational use exclusively by Instructional Television Fixed Service (ITFS) operators. Rules reallocated eight of those channels for outright commercial use, and educational organizations were permitted to lease excess

hours to commercial operators on the remaining 20 channels. In any local market, this makes it possible for a commercial operator to combine any or all of those 28 channels with five other channels already available for commercial use. Under current FCC rules, the available spectrum results in a maximum of 33 analog channels. This number of 'wireless cable' channels is less than the number offered on many competing franchise type cable television systems.

Since 1983 spectrum blocks in the 2.1 - 2.7 Ghz range have been allocated for the purpose of delivering video content from a single transmit site to multiple receive locations. A total of 198 Mhz has been allocated for downstream transmission for the wireless cable service. The channelization and transmission modulation (6 Mhz amplitude modulation/vestigial side band) are equivalent to broadcast TV or cable but up-converted to microwave frequencies.

The 33 channels potentially available to wireless cable operators therefore are subdivided into two types of channels. Twenty channels are referred to as ITFS. The remaining 13 channels are generally referred to as Multi-channel Multipoint Distribution Service (MMDS).

The current UHF spectrum was originally licensed in blocks of four video channels each separately licensed, with each block allocated to a specific purpose. Five groups, each with four channels, were allocated to Instructional Television Fixed Service (ITFS). ITFS spectrum was initially made available only to educational institutions. Two groups of four channels were made available to anyone wishing to provide an alternative multi-channel video program service. The final four channels were licensed individually to institutions for the purpose of providing a private video network. Over time, the FCC relaxed some of these operational rules. Through licensing and leasing arrangements, the FCC now

allows all of the channels to be aggregated for the purpose of providing an alternative to franchise cable television. However, even in areas where it is possible for one operator to aggregate the necessary licenses, the system capacity is still limited, i.e. to 33 channels or less.

In many ways, current typical UHF wireless TV is equivalent to at most a low tier franchise cable television system (i.e. having relatively few channels). Other than the number of program channels, the only real difference arises in the medium used to transport signals from the headend to the customer. Functionally identical headend equipment is utilized in both systems. In the case of UHF service, signals leave the headend via a microwave transmitter. With cable television, the same signals leave the headend on fiber or coaxial cable facilities. However, wireless cable systems have had difficulty competing because today many cable systems offer a more diverse range of programs.

Technical problems with microwave frequency broadcast also have limited the commercial practicality of the wireless cable services. As noted above, propagation characteristics at the relevant UHF operating frequencies require line-of-sight (LOS) between the transmit and receive antennas for reliable service reception. Both natural obstructions such as hills and vegetation, and man-made obstructions such as buildings, water towers and the like, limit the actual households capable of receiving an LOS transmission. Figure 1A also shows a simplified example of one such obstruction O. As illustrated, the obstruction O is within the primary reception area P. The obstruction blocks line-of-sight transmissions from transmitter antenna tower T in a radially extending blockage or shadow area B. Receiving systems within this area can not receive the transmissions from antenna T, and potential customers in

that area B can not subscribe to the wireless cable services broadcast from that tower.

One solution to the blockage problem has been to provide repeaters. A repeater receives the primary transmission from tower T on the tower side of the obstruction, amplifies the signal if necessary, and retransmits the signal into the area of blockage. This may be an effective solution to one blockage or obstruction O, but in many major metropolitan areas there are many obstructions. The power levels of such repeaters tend to be low. Overcoming blockages due to many different obstructions to the primary transmissions as well as distortions that result when amplifying combined RF channels would require an inordinate number of repeaters. Also, because of delays and multipath effects, repeater transmissions may interfere with reception from the primary source in areas close to the blockage area B.

In the industry, a nominal figure for households reachable by LOS is 70%, even with a small, commercially practical number of repeaters. This projected number is based solely on computer models, not actual field measurements. It is believed that actual coverage by the current wireless cable technology in the UHF medium is considerably lower. Typical antenna heights required to achieve the present level of coverage in commercial service are 800-plus feet for transmitters and 30-60 feet for receivers. That means that many receive antennas must be mounted atop masts or nearby trees as an alternative to a rooftop mounting. While current regulations provide a 15 mile protected service area for MMDS, it is desired that effective system coverage for approximately 40-70% of the affected households may be achieved to a 40 mile radius from the transmitter antenna.

Besides signal blockage, several other propagation factors can affect reliable UHF service delivery. One factor is multi-path reflections of the desired signal arriving at the receiver by way of differing paths and therefore arriving with slight delay. For analog video signals, multi-path appears as ghost images on the viewer's TV. For digital signals, multi-path can cause intersymbol interference that results in multiple bit errors. In either case, near-coincident multi-path signals can cause a degree of signal cancellation that looks like additional propagation loss. Multi-path also results from reflections and diffraction.

Path fading is another significant coverage factor. Time-variant path fading can result from atmospheric effects, e.g., rain or temperature and pressure inversions. Rain can act to partially reflect or absorb the microwave signals. Weather inversions can result in an upward bending of the wave front due to refraction. There are engineering measures to mitigate the troublesome effects of time-variant path fading, such as suitable fade margins and antenna diversity.

In the paging and radio communication fields, various systems of sequencing and simulcasting have been proposed to achieve some increased coverage. Examples of typical proposed systems are illustrated in Fig. 2 and 3. The related systems are described in U.S. Patents Nos. 3,836,726, issued September 1974 and 5,038,403 issued August 6, 1991. Figure 2 illustrates a system utilizing sequencing while Figure 3 illustrates a system utilizing simulcasting. As can be seen, the aim is to cover maximum area with minimum area of signal overlap. Even if someone suggested application to UHF Wireless Cable type communications, such propagation fields would still exhibit the above noted problems due to obstructions, multi-path interference and fading.

Clearly a need exists for a wireless broadcast system providing increased propagation coverage and reduced areas of blockages. Any such system should also provide an increased number of programs, without requiring additional spectrum allocation. The system should provide good signal quality throughout the entire reception area or service area. Accordingly, it is also desirable to minimize multipath interference and loss of service due to fading.

An additional set of problems arise in providing video service, such as the wireless cable service, to certain types of multiple living unit residences. For example, rewiring existing apartment complexes for fiber and/or cable often is not feasible, either because of prohibitive costs or because of difficulties in actually running the fiber or cable through existing buildings without substantially dismantling the buildings in the process.

U.S. Reissue Patent No. 34,611 to Fenwick et al. discloses a video distribution system for a multiple unit facility, such as a hotel or hospital. A central unit or hub transmits selected video programs over dedicated channels to a number of independently controlled video monitors. On a coaxial cable serving one group of the monitors, one frequency channel is dedicated to each monitor. The Fenwick et al. system provides only dedicated services, not broadcast services. Also, the Fenwick et al. system is an entirely analog system.

U.S. Patent No. 5,010,399 to Goodman et al. suggests a solution to the rewiring problem. This Patent discloses a system for transmitting signals between components of a video system over the telephone wiring of a residence. The Goodman et al. system, however, only provides transport from a single VCR to a plurality of televisions within one customer premises. Also, the Goodman et al. system provides analog NTSC signal

transport over the telephone wiring. Such transport is not feasible in a multi-unit dwelling because of cross-talk and other interference problems encountered in multi-pair cable runs.

Also, many planned development communities have restrictive covenants which run with ownership of the property. In such communities, whether the homes are town houses or single family homes, the covenants may prevent installation of visible outside receiving antennae. Also, only a few homes in the community may have a good location for a line of sight receiving antenna. In apartment complexes, the residents may not be able to locate a dish type antenna outside at all, or if allowed to have such an outside antenna, they may not have access to a point on the building from which to aim the antenna at the transmitter tower.

Another set of problems arise in installation of upgraded communications networks in multi-unit dwellings. The new networks require some type of sophisticated terminal device in each living unit, and often require one such terminal for each television in each living unit. These terminals often are prohibitively expensive. Even if initial installation is commercially feasible, maintenance of the terminals in a rental complex is not. At the best of times, most tenants do not adequately care for fixtures on the rental property and at times are deliberately destructive. Placement of expensive new terminals in rental units subjects those terminals to similar risks of damage. Also, some tenants may steal the expensive terminals, particularly when the tenants leave or are evicted.

Clearly an additional need exists for cost effective systems for supplying wireless cable broadcast signals to multiple living unit installations.

Disclosure of the Invention

The present invention provides methods and apparatus to address the above stated needs.

The present invention relates to a shared communication system serving a number of living units. Common or 'hub' equipment in the system receives multiplexed digitized information signals relating to a plurality of programs, preferably from a broadcast network. The common equipment includes means for processing the digitized information signals to derive separate program signals, each of which contains information relating to a single one of the of programs. Lines couple the common equipment to broadband output devices, e.g. television sets, in the living units. The common equipment includes a switch coupled between the means for processing and the lines, for routing selected program signals over the lines to individual living units. The system also includes a hub controller. The hub controller controls the routing functionality of the switch in response to program requests received via the lines.

In the preferred embodiments, the multiplexed digitized information signals comprise digital transport streams carried on multiplexed channels. Each digital transport stream contains multiplexed digital information relating to a group of the programs. The digital multiplexing of groups of programs into each channel increases the number of programs broadcast through a limited number of channels. The programs may be audio only or data, but in the currently preferred embodiment, a number of the broadcast programs comprise audio/visual information such as television programming. In such a television system, each program is digitally encoded into compressed digital data. A multiplexer combines the compressed digital data for a group of programs into one of the digital multiplexed data streams for transport

through one of the channels. The means for processing the digitized information signals includes a digital receiver and an associated demultiplexer, for processing signals from each of the multiplexed channels. Each digital receiver processes a different one of the multiplexed channels to recover the digital transport stream therefrom, and an associated demultiplexer demultiplexes each recovered digital transport stream, to thereby derive separate digital program signals.

The placement of the more expensive processing elements in the common or 'hub' equipment spreads the cost of such elements over all living units served by the shared system. Also, such elements typically are placed in a restricted location making them less susceptible to damage or theft. As much as possible, the terminal equipment in the subscriber premises is minimized, to minimize the cost of installing terminals in large numbers of living units and to reduce maintenance, damage and theft problems.

Two different embodiments are disclosed for transporting selected program signals to the individual living units, based on the type of wiring available in the multi-unit building or complex.

In a first embodiment, the lines to the living units comprise telephone loops, e.g. twisted wire pairs. In existing buildings, such telephone wiring is already in place and runs from an equipment room (e.g. in the basement) to the living units. New wiring often is unnecessary. In this embodiment, a modulator modulates each digital program signal into a frequency range and modulation format compatible with telephone line transport. In response to a selection request, the controller instructs the switch to route the modulated signal for the selected program through for coupling to the requesting subscriber's telephone line. A terminal in the living unit includes a demodulator and a digital

decoder to convert the selected program signal to a format for presentation on a television set.

In a second implementation utilizing coaxial cables, the common equipment includes digital decoders. One decoder processes each separate digital program signal. The decoders output baseband television signals. A modulator is coupled between an output port of the switch and each subscriber's coaxial drop cable. In response to a selection request, the controller instructs the switch to route the baseband signal for the selected program through to the modulator coupled to the requesting subscriber's coaxial drop cable. The modulator modulates the baseband signal into a television channel and transmits that channel signal over the drop cable to the subscriber's living unit. A standard television set directly receives the transmitted television channel signal and provides a television type audio/video presentation to the viewer. In this implementation, the equipment required in a living unit includes only the television, a remote control, an infrared transceiver and a data device to transmit program request messages over coaxial cable to the common equipment.

The preferred embodiment utilizes a wireless digital simulcasting network to broadcast the broadband information to various customer premises receiving systems, including one or more of the shared receiving systems discussed above. A signal including the multiplexed channels is transmitted simultaneously from a plurality of spaced transmitting sites. The transmitting sites propagate the signal into substantially overlapping regions of at least a major portion or the intended reception area. The overlapping transmission or propagation areas reduce or eliminate blockage zones and effects of fading. This technique also limits the number of receivers effected by equipment outages. Typically, a directional receiving antenna can

be aimed toward at least one strong line-of-sight transmission source.

Additional objects, advantages and novel features of the invention will be set forth in part in the description which follows, and in part will become apparent to those skilled in the art upon examination of the following or may be learned by practice of the invention. The objects and advantages of the invention may be realized and attained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

Brief Description of Drawings

Figure 1 is a simplified diagram of a prior art wireless cable television system.

Figure 1A shows service areas relating to a single wireless transmitter in the system of Figure 1.

Figures 2 and 3 show propagation areas for multi-transmitter systems used in other types of prior art systems, e.g. paging.

Figures 4 and 5 depict exemplary propagation areas for simulcast transmissions into a receiving area, in accord with one aspect of the present invention.

Figure 6 depicts in functional block diagram form the elements of the wireless broadcast transmission system used in accord with the present invention.

Figure 7 illustrates the high-level functional elements of a customer premises receiver system and a first preferred embodiment of a common or shared receiving system in accord with the present invention.

Figure 7A is a spectrum diagram (not to scale) of the frequency channelization on a telephone loop in the shared receiving system illustrated in Figure 7.

Figure 8 is a more detailed functional block diagram of a landline interface system used in the shared receiving system illustrated in Figure 7.

Figure 9 is a functional block diagram of the digital receiver and the demultiplexer/remultiplexer used in the landline interface system of Figure 8.

Figure 10 is a functional block diagram showing the elements of the system of Figure 7 located in the living unit in somewhat more detail.

Figure 11 illustrates the high-level functional elements of a customer premises receiver system and a second preferred embodiment of a common or shared receiving system in accord with the present invention.

Figure 11A is a spectrum diagram (not to scale) of the frequency channelization on coaxial drop cable in the shared receiving system illustrated in Figure 11.

Figure 12 is a more detailed functional block diagram of a landline interface system used in the shared receiving system illustrated in Figure 11.

Best Mode for Carrying out the Invention

The present invention contemplates use of a common or shared receiving system providing broadband services, typically from a broadcast network, over customer premises wiring to a plurality of individual living units in a multi-living unit complex. The broadcast network utilizes digital transport, and the common equipment performs as much of the processing of the digital signals as is possible for the particular installation. The terminal devices in the living units are relatively simple.

The detailed description below covers an entire end to end communication system. For ease of explanation, the following discussion will progress from source, through broadcast transmission, through shared processing to processing and display in the living unit.

In the preferred embodiment of the present invention, groups of program signals are digitally encoded and compressed, and the compressed program

streams are time division multiplexed into digital transport streams. Each digital transport stream is modulated and/or upconverted into one wireless broadcast channel. The channel is broadcast to a number of receiving systems, at least one of which is shared by a number of living units.

The broadcast may utilize a portion of a landline network. A preferred broadcast technique utilizes wireless broadcast transmission.

In a wireless broadcast implementation, the wireless channel typically is an RF channel in the high end of the ultra high frequency (UHF) microwave range (e.g. 2.1 to 2.7 GHz), although other frequency channels could be used. Separately located transmitters simultaneously broadcast a UHF frequency signal containing all of the channels. The transmitter antennae are located and the transmitter emission patterns are designed so that the waves from the transmitters propagate throughout substantially overlapping portions of the service area.

The overlapping portions may extend throughout the intended reception area. Existing regulations relating to the relevant frequency allocations specify a primary service area and a secondary service area. Within the primary service area, the regulations protect the licensee from any interference on the relevant frequency channel. In initial implementations of the present invention complying with such regulations, the overlapping areas of propagation from the multiple transmitters would cover at least a major portion of the primary reception area and preferably also cover a substantial portion of the secondary reception area. Some portions of the secondary reception area may be covered by propagating waves from only one of the transmitters. All of the primary and secondary areas would be covered by propagating waves from at least one of the transmitters.

Referring to Figure 4, the circle PA defines the Protected Area or primary area which may be serviced from a transmitting antenna TX1. At present, the radius of this circle is 15 miles. However, usable signal and acceptable reception generally occurs to a radius of 40 miles which is here defined by the circle MA indicating the Maximum Area. The region between the 15 mile radius circle and the 40 mile radius circle forms a 'secondary' service area. According to the invention, all or part of the rights of an educational institution for ITFS service are leased. Also, licenses are aggregated, from companies currently licensed to use MMDS channels. Existing analog services (both ITFS and MMDS) are replaced by the new service which will provide the original programming desired by the ITFS institution in addition to a multiplicity of programs made possible by the system and method of the invention. In order to achieve this end, simulcasting is utilized in a unique manner.

Referring to Figure 4 there is shown one preferred embodiment of a simulcast arrangement utilizing the original antenna TX1 in addition to antennas TX2, TX3 and TX4 disposed in a generally triangular configuration within or on the boundary of the Protected Area (PA). According to this embodiment of the invention, all antennas radiate in an omni-directional pattern in azimuth as indicated by the circles TX2-A, TX3-A and TX4-A. The central antenna TX1 radiates out to the maximum area MA, in a manner permitted by existing regulations, as discussed above relative to Figure 1A. A major portion of the protected area (PA) is overlapped by the signals from all antennas TX1, TX2, TX3 and TX4. In the Maximum Area (MA) considerable overlap continues to exist but to a lesser extent. In this manner it has been found possible to reach receivers in approximately 90-95% of the maximum area (MA).

Referring to Figure 5 there is shown a second preferred embodiment of simulcasting utilizing directional antennas TX2, TX3 and TX4. In this embodiment the central antenna TX1 retains its omni-directional pattern. However, the antennas TX2, TX3 and TX4 are provided as directional antennas radiating forward and backward lobes TX2F and TX2B for antenna TX2, TX3F and TX3B for the TX3 antenna and TX4F and TX4B for the TX4 antenna. In both the embodiments of Figures 4 and 5 it will be seen that there is a radical departure from the minimum overlap approach which is conventional in the systems illustrated in Figures 2 and 3.

The simulcast transmission from the broadcast antennae include a plurality of frequency multiplexed channels. Each channel contains a digital transport stream carrying a number of programs, in compressed digital form. The programs may be audio only programs, or data, but in the preferred embodiments, the programs are television type programs. The television type programs contain video and audio information, and may include data information, e.g. for closed captioning and the like. The system and method for transmitting the simulcast signals and receiving those signals within the service area are now briefly described.

With reference to Figure 6, the broadcasting portion of the system includes a headend 10. The headend includes a number of Sources S1 to SX for producing digital transport streams, each of which contains a plurality of programs encoded as digital, compressed data. The number of such sources corresponds to the number of frequency channels available for use in a particular geographic region. Typically, the FCC licenses up to 33 channels of MMDS and ITFS services in a given area. It may be possible to aggregate rights to use all such channels, but to provide a commercially viable service, typically only 20-25 such channels are

necessary. The headend 10 therefore typically comprises 20-25 of the Sources S1 to SX, but may include as many as 33 such sources. The Sources S1 to SX may convert analog program information from video sources, (e.g. off-the-air feeds, satellite receivers, VCRs, etc.) into compressed, digital data form. The headend 10 may also receive and process previously encoded material.

The video information, accompanying audio information and certain related data (if any) are encoded using a standardized digitization and compression technique, such as MPEG (moving pictures expert group) or DIGICIPHER™. The preferred embodiment utilizes MPEG II encoding. Figure 6 illustrates the overall architecture of the broadcasting system. As part of the headend 10, that drawing provides a simplified diagram of the source encoder functionality, e.g. at S1, for preparing a group of original analog source signals for transport through the network. As shown, each analog television signal, e.g. in NTSC format, is applied to an MPEG encoder 11. The encoder 11 digitizes both audio and video for a program, and packetizes the compressed digital data in accord with the appropriate standard. The encoder may also encrypt the data before insertion thereof into the transport packets.

MPEG is a bi-directional predictive coding compression system, utilizing discrete cosine transformation (DCT) processing. Picture elements are converted from spacial information into frequency domain information. Compression begins by discarding information to which eyes are insensitive. From the remaining information, the encoder will develop reference (I) frames, predictive (P) frames and delta (B) frames.

The number of frames to be coded for each I frame is set in the standardized MPEG syntax, e.g. one reference frame for each group of fifteen frames, or every half second. A prediction is made of the composition of a

video frame, termed a P frame, to be located a specific number of frames forward and before the next reference frame, this specific number also is set in the MPEG syntax. Information from previous video frames as well as later video frames is used in formulating the prediction. "Delta" or "B frame information is developed for coding the video frames between the actual and predicted frames, also by looking at frames in both directions. Rather than updating a whole frame, only the changed (or delta) information is provided for the delta video frames. Thus the total information coded, and then transmitted, is considerably less than that required to supply the actual information in the total number of frames. Typically, between I frames, the frame sequence consists of a repetitive succession of two B frames followed by one P frame.

The MPEG II standard provides a standardized format for packetizing the compressed audio and video information and for transporting other data. Under the MPEG II standard, incoming individual video signals and related audio signals are encoded and packetized into respective Video and Audio Packetized Elementary Streams (PES). The video and audio PES's from one or more sources of video programming may be combined or multiplexed into a transport stream for transmission or storage.

Each frame of compressed program information (audio, video or data) is broken down into a series of transport packets. Although the frames can vary in length, e.g. between a full reference I-frame and a delta B-frame, the transport packets have a fixed 188 byte size. Thus, different frames are broken down into different numbers of MPEG transport packets. For example, in a 6 Mbits/s encoding system, a group of frames consisting of a total of 15 frames for one-half second of video (one I frame and a number of P and B frames), breaks down into

approximately 2000 transport packets (or 4000 packets per second).

Each 188 byte transport stream packet consists of two sections, a 4 byte packet header section, an optional adaptation field and a payload section. The header information includes, inter alia, a synchronization byte, a variety of different flags used in reconstruction of the frames, and a thirteen bit program identification (PID) number. PID value 0 is reserved as an indication that the packet includes program association table data. PID value 1 is reserved for identification of packets containing conditional access data, such as encryption information. Other program identification numbers are utilized to identify transport packets with the program or source from which they originate.

Periodically, the transport packet for each program will also include a program reference clock (PRC) value within the optional adaptation field. In a typical 6 Mbits/s MPEG encoding system, the PRC is present in at least 10 and preferably 20 out of every 4000 video transport packets, i.e. a relatively small number of transport packets.

When included, the optional adaptation field includes a section for miscellaneous flags, such as discontinuity counter, private data flag, etc. One of the possible flags carried in this portion of the adaptation field is a program clock reference (PRC) flag. The adaptation field (AF) also includes a section designated for AF options. One of the options this section may carry is the PRC value.

On decompression, the decoder in sequence reconstructs the frames for a particular program from packets bearing the appropriate PID value, uses the reference frame to form the prediction frames, and then uses the prediction frames and delta information to construct full frames from the delta frames. The decoder

uses the PRC values to synchronize decoding to the original encoding operation.

The MPEG II standard facilitates time division multiplexing of MPEG packets from a plurality of programs. In the present system, the encoders 11 supply MPEG packet streams for multiple programs to an MPEG multiplexer 12. The number of programs may vary depending on the bandwidth. The MPEG multiplexer 12 may receive digitized and compressed (MPEG) video from other sources 11'. Typical digital sources 11' include digital server (storage) systems and digital video transmission systems (e.g. satellite or optical fiber).

As discussed below, a typical multiplexed digital transport packet stream used in the present invention has 27 Mbits/s of payload capacity. A mixture of program streams for individual programs at different individual rates, e.g. 1.5 Mbits/s, 3 Mbits/s and 6 Mbits/s, may be combined to fully utilize the 27 Mbits/s capacity. In one example, the 27 Mbits/s multiplexed digital transport packet stream might consist of three 3 Mbits/s programs and three 6 Mbits/s programs. For simplicity of further discussion, however, assume encoding of programs at a 6 Mbits/s rate, therefore the multiplexer 12 combines four MPEG II packet streams of four such programs for output on each broadband rail.

The simplified example therefore provides four programs for one RF channel, i.e. a 4 to 1 improvement over the existing single analog program channel. The other mix of three 6 Mbits/s programs and three 3 Mbits/s programs provides six programs for one RF channel, i.e. a 6 to 1 improvement. Lower bit rates and/or more efficient modulation techniques can further extend the program capacity provided through each RF channel.

In a typical example, there are at least three PID values for packets of a particular television type program encoded in MPEG II form, a first PID value for

packets containing video, a second PID value for packets containing audio and another PID value for a packet containing a program map. There often are more than three PID's associated with the packets containing programming from one source. For example, there could be a data channel associated with the program which would include data for closed captioning for the hearing impaired and/or related control signaling information. There could be a number of audio elementary streams, for example, carrying respective different language audio tracks. The program map, in turn, specifies the PID values for the various packets containing video, audio and/or data from the particular source.

In a combined MPEG packet stream carrying packets for two or more programs, the PID values for each program will be unique, and each such program is assigned a unique program number (PN). For example, HBO might have a program number '1', and the program map for HBO might be found in packets corresponding to PID 132. Showtime might have a program number of '2', and the program map for Showtime might be found in packets identified by PID 87 and so forth. The program map for HBO in the packet with PID 132 would then identify the PID numbers for the actual packetized elementary streams (PES) for the video, audio and data (if any) channels associated with the HBO program. The program map for Showtime in the packet with PID 87 would then identify the PID numbers for the actual packetized elementary streams (PES) for the video, audio and data (if any) channels associated with the Showtime program.

The MPEG II standard also requires that a packet stream containing packets relating to one or more programs includes a program association table in a packet identified by PID 0. The program association table maps each program number with the PID value associated with the program map related to that source. In accord with

the standard, each MPEG II multiplexer 12 combines MPEG packet streams for the four (or more) input programs and adds a PID 0 packet containing the program association table to the combined stream. In the above example, the program association table would map program number '1' (HBO) with PID value 132 indicating that the program map for HBO is contained in repeating packets identified by PID 132. Similarly, the program association table would map program number '2' (Showtime) with PID value 87 indicating that the program map for Showtime is contained in repeating packets identified by PID 87.

A decoder can receive and process material relating to one program in a transport stream using the program and the program number (PN). In such an implementation, the MPEG decoder uses the information contained in the PID 0 packet to identify the PID value for the program map for the particular desired program, e.g. 132 in the above HBO example, and uses the program map to identify the PID values needed to capture the video, audio and user data (if any) for the desired program. Alternatively, the decoder may be supplied with PID value information for the actual video stream, audio stream and data stream (if any) associated with the program, e.g. from a table in memory or from information received via a separate signaling channel. However, even if the decoder does not utilize the program association table and the program maps, these packets are included in the MPEG transport streams output by the multiplexers 12 to insure full compliance with the MPEG II syntax.

In the present embodiment, each multiplexer 12 outputs a group of MPEG encoded programs, i.e. four if the encoding rate of all encoders 11 is 6 Mbits/s, at a combined payload rate of 27 Mbits/s (it may be necessary to pad the steam with dummy packets to reach the full 27 Mbits/s). The actual stream will include an additional 3 Mbits/s of forward error correction information for a

combined rate of 30 Mbits/s, although hereinafter for convenience the bit stream is generally described by its 27 Mbits/s payload rate.

The 27 Mbits/s payload (actually 30 Mbits/s including forward error correction bits) baseband digital output of each MPEG multiplexer 12 from one of the sources S1 to SX goes to a modulator 13. U.S. Patent No. 5,231,494 to Wachob, the disclosure of which is incorporated herein in its entirety by reference, teaches quadrature phase shift keyed (QPSK) modulation of a plurality of video, audio and data signals into a single data stream within a standard 6 Mhz channel allocation for transmission over a cable television type distribution network. The currently preferred implementation uses 64 QAM (quadrature amplitude modulation) or 16 VSB (vestigial sideband) modulation techniques in the modulators 13. Using 64 QAM, 4 channels of 6 Mbits/s or a mix of 1.5, 3 and 6 Mbits/s encoded digital video information up to a total of 27 Mbits/s together with 3 Mbits/s of forward error correction information can be modulated into one 6 Mhz bandwidth analog channel. Similarly, 256 QAM or 16 VSB would yield up to 40 Mbits/s payload of capacity (not counting bits added for forward error correction), e.g. for 6 channels of 6 Mbits/s or mixes of the various rate encoded digital video information modulated into one 6 Mhz bandwidth analog channel. Each modulator 13 produces a 6 Mhz bandwidth output at an intermediate carrier frequency.

Each modulator 13 outputs the intermediate frequency signal to an individual upconverter 14. The upconverter converts the frequency of the QAM modulated signal up to one of up to thirty-three RF channel frequencies in the 50-450 Mhz range. The upconverter 14 may be an element of the QAM modulator 13 or a separate element as shown hard wired to process the output of the QAM modulator.

Each upconverter 14 outputs a different 6 MHz bandwidth RF channel to an RF combiner 15 for combining with the other 6 MHz RF signals from the other upconverters 14. The RF combiner 15 thereafter outputs the combined RF signals in the normal video channel range of approximately 50-450 Mhz. The upconverters 14 and the RF combiner 15 may be the same as components currently used for RF signal processing in cable television systems. Broadcast channels of this type can ride on a landline broadband distribution network, e.g. a cable broadcast network or a hybrid-fiber-coax network similar to networks used as cable TV systems.

For the preferred wireless type broadcast system, a transmission network supplies the combined spectrum signal in the 50-450 MHz range from the combiner 15 to a number of wireless broadcast transmitter systems $17_1$ to $17_n$. The transmitter systems $17_1$ to $17_n$ correspond to the transmitters TX1 to TX4 described above with respect to Figures 4 and 5. Although coaxial cable, wireless microwave relay transmissions or other media could be used, in the preferred embodiment, the transmissions from the headend 10 ride on optical fiber lines 18. In the preferred embodiment, an electrical to optical converter system 16 converts the signal from combiner 15 into optical signals for transmission over a plurality of optical fibers 18. An optical to electrical unit 20 at each transmitter site converts the optical signal back to the combined electrical signal and supplies that signal to one of the transmitter systems 17.

An important feature of the present invention relates to simulcasting, i.e. simultaneous broadcasting, of the combined spectrum UHF signal from a plurality of and possibly all of the transmitter towers TX1 to TXN. The optical fiber signal transmission from the headend 10 to the transmitter systems requires some finite amount of time. Typically, the transmitter systems will not be

equi-distant from the headend. In fact, one of the transmitter systems may be in the same building as the headend. To insure substantially simultaneous broadcasting, the system shown in Figure 6 therefore includes some form of delay 19 in one or more of the transport lines 18. The delay may take the form of coils of fiber to equalize the optical transport paths and therefore the time through each path. Alternatively, one or more electronic delay devices may be imposed in the relevant paths, either at the headend prior to optical transport or at the respective transmitter location subsequent to conversion back to electrical signal form.

There may be as few as two transmitters. In a typical example, there will be a central transmitter site TX1 and two or three other transmitter sites TX2, TX3 and TX4 at various locations about the primary reception area (see e.g. Figures 4 and 5). The headend may be close to the central transmitter site TX1, therefore the transport distance to that site would be the shortest. Assume now, for example, that TX4 is the longest distance from the headend. To provide an actual simultaneous broadcast, the delay produced by delay device 19 will be equal to the difference in the time required to transport optical signals from the headend 10 to those two sites, i.e. so as to result in simultaneous in-phase transmission of the exact same signal from the antennae at the two transmitters TX1 and TX4. Similar delays are imposed in the lines 18 to the other transmitter systems. Alternatively, at least two transmitters on the periphery may transmit substantially simultaneously, whereas one or more of the other transmitters (e.g. the central transmitter) may broadcast the signal at a predetermined time prior to the transmissions on the periphery to provide a precise time offset.

Figure 6 also shows details of one of the wireless transmitter systems 17N, by way of an example. Each

transmitter system includes a splitter 21. The splitter 21 together with associated channel selection filters 22 divide the received combined signal (50-450 MHz) into its constituent 6 MHz wide RF channels. For each 6MHz channel in the 50-450 MHz range, one of the upconverters 24 converts that channel into one of the up to thirty-three available (licensed) channels in the UHF microwave range. An RF power amplifier 23 amplifies each UHF channel.

A delay device may process each channel signal, and by way of example, Figure 6 shows a delay device 26 processing the output of each of the upconverters 24. The delay devices 26 provide precise delay compensation on each respective channel to compensate between variations in throughput processing time of the various components at different transmitter sites operating on the signal to be broadcast on a particular microwave channel.

A microwave combiner 25 combines the UHF channel signals back into a combined spectrum signal in the UHF range and supplies that signal to a microwave broadcasting antenna 27. Each transmitting antenna may be an omni-directional antenna or a directional antenna. The type of antenna at each transmitter site is selected to give the optimum coverage in a particular geographic service area. The antenna 27 emits UHF waves to propagate through a portion of the service area. For each channel, the resultant broadcasts from all of the transmitters are synchronized and in phase with each other. The transmitted microwave signals propagate into substantially overlapping portions of the service area and into some non-overlapping portions of that area, for example in patterns such as shown in Figures 4 and 5.

The above discussion of the headend and transmission systems is one example of an overall system for providing the preferred simultaneous, synchronized, in-phase

broadcasts from multiple transmitters having substantially overlapping propagation areas. Other headend and transmitter systems could be used. For example, the headend 10 could perform the digital multiplexing, and the transport network to the transmitters TX1 to TXN could carry the multiplexed transport streams in digital form. In such a case, the individual transmitter systems would further include at least the QAM modulators for each RF channel. In such a system, the transmitters may include means to synchronize processing and broadcast transmissions to some common clock, e.g. from a geo-positioning type satellite system, to achieve the simulcast transmission.

Figure 7 provides a high-level functional diagram of the receiving systems used in the present invention.

In accord with the invention, a group of users or locations will have a shared receiving system $R_s$. The users could be in different rooms or living areas (units) within one customer premise. In most cases, however, the shared system services living units occupied by different users, e.g. tenants in hotel rooms, apartments or the like. In this first embodiment, the subscribers telephone loops 34 serve as the video drops carrying selected program signals to terminals in the living units serviced by the shared system.

The shared receiving system includes at least one and typically a plurality of directional microwave antennae, aimed at one of the transmitters TX1 to TXN. In the preferred implementation, the system $R_s$ includes the same number of microwave receiving antennae $31_1$ to $31_N$ as there are transmitters TX1 to TXN serving the region. In such a preferred system, one of the microwave receiving antennae $31_1$ to $31_N$ is aimed at each of the transmitters TX1 to TXN. This arrangement provides angular diversity in the broadcast waves received through these antennae. Because of the shared use by multiple

customers, the size, gain and quality of these antennae can be relatively high. Also, since there is only one set of antennae, presumably, the antennae can be placed at one or more sights on community property or on the top of the apartment building where the group of customers reside.

The microwave receiving antennae $31_1$ to $31_N$ may be mounted on a relatively high mast to provide clear line-of-sight reception from all of the transmitters serving the region. Alternatively, the antennae $31_1$ to $31_N$ may be located at different vantage points around the development. In a single family home community or in a town house development for example, each individual microwave antenna could be located on a different home, as agreed by the home owners, so as to provide line-of sight reception from the desired one of the transmitters TX1 to TXN. For example, one home at one end of the development may have a clear line-of-sight to one transmitter tower, a second home at the other end of the development may have a clear line-of-sight of the second transmitter, etc. Antennae located on those homes are connected to the shared processing circuitry 33. On an apartment or hotel building, each individual antenna could be located at a different one of the corners of the building, so as to provide the necessary line-of sight reception from the desired one of the transmitters TX1 to TXN.

Signals from the microwave receiving antennae $31_1$ to $31_N$ all go to shared wireless signal processing circuitry 33. The shared wireless signal processing circuitry 33 processes the signals from the microwave receiving antennae $31_1$ to $31_N$ to produce a single high quality RF spectrum signal downconverted into at least a portion of the 50-450 MHz range from the microwave transmissions. Exemplary systems for use as the shared wireless signal processing circuitry 33 are disclosed in detail U.S.

Patent application Serial No. 08/441,977 filed May 16, 1995 entitled "SHARED RECEIVING SYSTEMS UTILIZING TELEPHONE CABLES AS VIDEO DROPS" (attorney docket no. 680-130B), and the disclosure of the shared wireless signal processing circuitry from that application is incorporated herein in its entirety by reference.

The shared wireless signal processing circuitry 33 outputs the processed channel signals through a coaxial cable or the like to a landline interface system 32. The landline interface system also connects to a telephone company central office 45, e.g. through a subscriber line carrier system (not shown in detail). The landline interface system 32 may also provide a connection to a node 55 of a landline based broadband network, such as a switched digital video (SDV) network. The landline interface system processes all received broadcast signals from the wireless transmission (and from the SDV node if so connected) to derive separate signals for each individual broadcast program and supplies selected signals over the telephone loops 34 to the individual living units 75.

In an apartment building or hotel, the landline interface 32 typically is located in the telephone wiring closet. In a housing development, the landline interface 32 typically occupies a binding post distribution cabinet, e.g. in a controlled environmental vault.

The landline interface system 32 provides a downstream interface for selected channels from the output of the shared wireless signal processing circuitry 33 to the telephone lines 34 serving the living units 75. The telephone wiring may include optical fiber, coaxial cable etc., but typically, the telephone wiring consists of twisted wire copper pairs. At least one such pair goes from the landline interface 32 to each living unit 75.

The landline interface system 32 also interfaces the telephone wiring 34 to the lines or trunks to the CO 45 to provide subscribers with plain old telephone service (POTS). The CO 45 in turn connects to other elements of the public switched telephone network (PSTN), in the normal manner.

Each living unit 75 includes a network interface device (NID) 35 connected to a respective telephone line 34. The NID 35 provides one or more telephone devices 41 with a two-way voice band connection to the line 34. Although shown as telephones, the telephone devices 41 may comprise any devices compatible with ordinary telephone lines, e.g. facsimile machines, modems, etc. The NID 35 also provides a two-way connection to a terminal 100, utilizing specific higher frequencies discussed below with regard to Figure 7A.

The terminal 100 responds to subscriber input signals, e.g. from a wireless remote control device 85. The terminal 100 transmits a packetized data message through the NID 35 and the telephone line 34 upstream to the landline interface 32, for example, indicating a newly entered program selection.

In operation, the landline interface system will supply a selected program signal, as a single program MPEG II transport stream modulated on an appropriate channel for twisted wire pair transport. The landline interface system 32 transmits the modulated signal for a requested program through the telephone line 34 and the NID 35 to the terminal 100 in the living unit 75 of the requesting subscriber. Each terminal 100 includes an appropriate demodulator and a digital decoder (see Figure 10) to convert the received signal to a signal compatible with the television 99. The TV 99 presents the program to the viewer in sensorially perceptible form, in this case, as a standard audio/visual output.

The simulcast wireless transmissions in accord with the present invention will also service customers not associated with a shared receiving system, such as the system $R_s$. Such other customers will have their own wireless receiving system $R_1$. For example, if such a customer is a home owner, that customer's system $R_1$ would include a small dish type directional antenna 31, a block downconverter 39 and a coaxial distribution system connected to one or more terminals 100' (only one shown).

Typically the antenna 31 is an elliptical dish shaped antenna 18 inches or less in diameter, formed of parallel curved elements. The dish 31 is aimed at the one transmitter TX1 to TXN which produces the strongest received signal through the antenna at the subscriber's particular location. The receiving antenna 31 supplies the 2.1 to 2.7 GHz spectrum (through appropriate filtering and/or amplifiers not shown) to the block down-converter 39.

The block downconverter 39 converts the 2.1 to 2.7 GHz signal, containing all of the wireless broadcast channels, back down to the video channel band of 50-450 MHz. The block downconverter supplies the 50-450 MHz combined spectrum signal via a coaxial cable to one or more terminal devices 100' located at various places in the subscriber's home. The single residence system may have only one terminal, but in many instances, the signals will be distributed to up to four terminals located throughout the home at desirable television viewing locations.

The terminal 100' in the residential system $R_1$ typically includes an interface module and a digital signal processor. In the single residence system $R_1$, the interface module functions as a wireless signal processor to process a selected one of the 6 MHz channels and recover the digitally multiplexed transport stream carried in that channel. The digital signal processor 37

processes data packets for the selected program from the multiplexed stream to produce signals to drive the TV 99. The TV 99 presents the program to the viewer in sensorially perceptible form, again as a standard audio/visual output. Commonly assigned copending U.S. Patent application Serial No. 08/405,558 filed March 16, 1995 entitled "SIMULTANEOUS OVERLAPPING BROADCASTING OF DIGITAL PROGRAMS" (attorney docket no. 680-130) provides a more detailed disclosure of the receiving system and terminal structures used in a single living unit type installation, and the disclosure thereof from that application is incorporated herein in its entirety by reference.

In each of the receiving systems, each antenna is aimed at one of the transmitters TX1 to TXN. Even so, the antenna receives multiple copies of the transmitted waveform signals. These multiple copies or replicas include a primary direct line-of-sight transmission of a signal from the transmitter the antenna is directed towards together with delayed copies (typically delayed and distorted) caused by reflections of the transmissions from one or more of the multiple broadcast sites. Also, at locations in the secondary reception area, the direction of reception by the antenna may actually be substantially in line with two of the transmitters. In such a case, the antenna would receive a first copy of the combined spectrum transmission from the closest transmitter followed by a delayed copy transmitted from the more distant of the two aligned transmitters.

The present invention therefore contemplates inclusion of some form of delay processing in the receiver to compensate for the reception of multiple delayed copies of the transmitted program signals. The presently preferred embodiment utilizes a delay equalizer as described in the above-incorporated commonly filed U.S. 08/405,558 Application. As an alternative, the

processing circuitry could utilize spread spectrum technology, as discussed in more detail in commonly assigned U.S. Patent application Serial No. 08/405,685, filed March 17, 1995 (attorney docket no. 680-117) entitled "Television Distribution System and Method," the disclosure of which is incorporated herein in its entirety by reference. As discussed more fully below, the delay processing circuits, e.g. delay equalizers, are provided as elements of the landline interface system 32 in the shared receiving system $R_s$.

One example of a frequency channelization for use on a twisted wire pair type telephone loop 34 appears in Figure 7A. In the illustrated example, the POTS signals for two-way voice frequency communication utilize a two-way channel in the 300 Hz to 4 kHz range. This is essentially standard POTS telephone service. A higher frequency channel provides analog modulated transport for a digital transport stream representing a single selected program. The downstream broadband channelization is similar to that used in Asymmetric Digital Subscriber Line (ADSL) system, and similar modulation techniques are used (e.g. CAP, DMT or the like). The frequency allocation on the loop 34 also provides at least a one-way (upstream) signaling channel. In the preferred example illustrated in Figure 7A, a two-way signaling channel is provided between the broadband downstream channel and the low frequency POTS channel. The signaling channel carries packetized data communications using QPSK modulation. Persons skilled in the art will recognize that a variety of frequency values can be used for the various channels shown in Figure 7A.

Figure 8 illustrates the functional elements of an exemplary implementation of the landline interface system 32. For simplicity of discussion, it is assumed here that the landline interface system 32 receives only broadcast signals from the wireless broadband

transmission system of Figure 6. The illustrated system 32 therefore includes processing elements to derive a digital transport stream for each wireless broadcast program. Additional processing circuitry (not shown) would be provided to derive signals for programs supplied through the SDV node 55 (Figure 7).

A splitter 101 receives the combined spectrum signal in the 50-450 MHz range via the coaxial cable, directly from a downconverter in a single receiving antenna installation or from the shared wireless signal processing circuitry 33 in a multiple receiving antenna implementation such as that shown in Figure 7. The splitter supplies the combined spectrum signal to each of a plurality of digital receivers 103.

The landline interface system 32 includes at least one digital receiver 103 for each of the broadcast channels received by the system 32. In operation, one digital receiver 103 processes each single one of the broadcast channels contained in the 50-450 MHz signal.

One or two additional digital receivers may provide a level of redundancy, i.e. so that a spare receiver may be activated to replace an inoperative receiver. Each digital receiver connects to an associated 'Demux/Remux' circuit 105, and each 'Demux/Remux' circuit 105 in turn connects to a bank of modulators 107. Corresponding spare 'Demux/Remux' circuits 105 and modulators 107 would be provided with the spare digital receivers.

Each digital receiver selects one broadcast channel and processes that signal in the frequency spectrum for that channel to capture the transport stream therefrom. In the implementation discussed above, the transport stream is a 27 Mbits/s digital signal. The digital receiver performs the demodulation, forward error correction, etc. to recover the transport stream from the selected 6 MHz wide channel in the 50-450 MHz range received via the coaxial cable. Each digital receiver

103 supplies a 27 Mbits/s transport stream, containing a plurality of programs to a digital signal processor identified as a 'Demux/Remux' circuit 105.

The Demux/Remux circuit 105 separates out a digital stream for each individual program carried in the broadcast transport stream. In the preferred implementation under consideration here, the broadcast transport stream at 27 Mbits/s contains four programs, each encoded at a 6 Mbits/s rate. Each Demux/Remux circuit 105 therefore outputs four new digital transport streams each containing packets for a single program together with overhead packets to conform to the MPEG II syntax at a combined rate slightly higher than 6 Mbits/s.

Figure 9 shows the elements of one digital receiver 105 and associated Demux/Remux circuit 105 in somewhat more detail.

The digital receiver 103 includes a band-pass filter 171. The bandpass filter 171 selects one of the broadcast channels from the received 50-450 MHz spectrum signal supplied through the splitter 101. The bandpass filter 171 may be a fixed frequency filter. At least for those digital receivers used as back-up units, the bandpass filter 171 comprises a frequency selective tuner, permitting tuning to the channel normally processed by a temporarily out of service receiver 103.

The bandpass filter 171 supplies the selected frequency channel portion of the received spectrum to a demodulator 172. The demodulator 172 demodulates the received channel spectrum, using a demodulation technique corresponding to the modulation used in the particular broadcast headend (e.g. 64 QAM).

The digital receiver 103 also includes, a time domain adaptive digital equalizer 173 and forward error correction circuitry 174. A clock circuit 175 provides synchronization for the digital output of the demodulator

172, the adaptive digital equalizer 173, and the forward error correction circuitry 174.

The time domain adaptive digital equalizer 173 receives the output of the QAM demodulator 172. Because of the multi-path delays and possibly offset arrival of the overlapping transmissions from multiple transmitter sites, the output of the demodulator 172 will not be a clean digital pulse stream. Instead, the signal will be a composite of time delayed copies of the transmitted digital information. The time domain adaptive equalizer 173 includes a multi-tap digital delay line, the length of which defines the time window of the delay equalizer. The outputs from the taps of the delay line may be weighted and summed, and the sum processed by a level detector or the like to recapture the original symbols (e.g. 1s and 0s of a digital stream). Examples of digital delay equalizers which may be used in the receivers of the present invention are described in Proakis, "Digital Communications," second edition, 1989, McGraw-Hill, Inc., chapter 6, although still other types of delay equalizers known to skilled technicians may be used. The forward error correction circuit 174 processes the recaptured symbols (e.g. 1s and 0s) to determine if each is in the proper position in the stream.

A control interface 176 provides appropriate control signals to the elements of the digital receiver 103 in response to instructions from a hub controller 115 (Figure 8). The digital receiver 103 processes signals selected from one of the RF channels by operation of the bandpass filter 171 to capture one of the digital transport streams (e.g. only 27 Mbits/s payload assuming 64 QAM). The digital receiver 103 outputs the transport stream as a corrected serial baseband digital feed to the associated Demux/Remux circuit 105.

In the illustrated implementation, the Demux/Remux circuit 105 includes a decryptor 181. The hub controller

115 (Figure 8) controls all authorization functions of the shared receiving system $R_s$, including decryption. As shown in Figure 8, the decryptor 181 receives authorization instructions from the hub controller 115. When properly authorized, the decryptor 181 decrypts payload data within packets of a each program in the transport stream output by the digital receiver 103. The decryptor 181 outputs a composite MPEG transport multiplex stream (e.g. at 27 Mbits/s) with appropriately decrypted components for the various programs contained therein to an MPEG demultiplexer 183.

In response to instructions from the hub controller 115, the MPEG demultiplexer 183 analyzes PID values of the packets in the transport stream to recognize packets for the different programs in the transport stream. On that basis, the MPEG demultiplexer 183 separates out the packets for each program and supplies the packets for each program on one of the outputs of the demultiplexer. In the present example assuming four 6 Mbits/s programs contained in the transport stream, the MPEG demultiplexer 183 will output the packets for each 6 Mbits/s program on one of four different output rails.

Each output of the MPEG demultiplexer 183 consists of MPEG II transport packets containing the video, audio and data (if any) for one broadcast program. If necessary, processing circuitry 185 may add necessary overhead packets (e.g. PID 0 packets, PID 1 packets, PMT packets, etc.) to conform each single program stream from the demultiplexer 183 to the MPEG II syntax.

Returning to Figure 8, the Demux/Remux circuits 105 supply each recovered individual program stream to a modulator 107. The modulators provide ADSL type line encoding of digital bit streams for twisted wire transport. However, because these units are providing only the downstream transport, full asymmetrical modem capability is unnecessary. The units 107 provide

downstream modulation only, typically using carrierless amplitude phase modulation (CAP), discrete multi-tone (DMT) modulation, or other ADSL type line code modulation.

Each modulator 107 outputs a modulated signal in the broadband higher frequency channel indicated for ADSL line code in the spectrum chart shown in Figure 7A. The modulated signal output by each modulator carries the MPEG II transport stream for a single one of the broadcast programs.

The modulators 107 supply the analog broadband channel signals to input ports of a switch 109. As such, the switch 109 receives a modulated analog signal representing each one of the broadcast programs received by the landline interface system 32. Assume for example that the wireless broadcast system has MMDS and ITFS licenses for 30 channels in the relevant portion of the UHF microwave range and encodes and multiplexes 4 programs for transport in each licensed channel. The landline interface system 32 therefore includes 30 operative digital receivers 103 and 30 operative Demux/Remux circuits 105. The landline interface system 32 includes 120 (4x30) operative modulators 107 supplying 120 separate modulated program signals to the input ports of the switch 109.

The switch 109 has one output port for each twisted wire pair 34 used to transport programming from the system 32 to the individual living units 75. Under control of the hub controller 115, the switch 109 routes any selected one of the modulated program signals on its input ports for output through a splitter/combiner 111 to the any one of the subscriber loops 34. Each splitter/combiner 111 includes an appropriate directional coupler and appropriate filters to route the signal in the channel assigned to the ADSL line code through from

the switch 109 to the connected twisted wire pair loop 34, i.e. in the down stream direction.

The switch 109 can connect a single input port to a single output port, if only one subscriber requests a particular program. The switch 109 also has multi-point connection capability. This means that the switch 109 can connect any one input port to a plurality or all of its output ports, for example if a large number of subscribers request the same program at the same time.

As noted above, a signaling channel is provided over each subscriber loop 34. Although other modulation techniques and/or channelizations could be used, the presently preferred embodiment utilizes QPSK modems 113 operating in a frequency band between the POTS channel and the downstream broadband channel. In such an implementation, the QPSK modems 113 provide a two-way data signaling capability between the terminals 100 in the individual living units 75 and the hub controller 115 in the landline interface system 32.

Each QPSK modem 113 connects to one of the telephone loops 34 through an associated one of the splitter/combiner units 111. Each QPSK modem 113 receives the spectrum channel for upstream signaling from the line 34 via the splitter/combiner 111, demodulates signaling data received via that channel and supplies the data through an appropriate interface to the hub controller 115. The hub controller 115 identifies the subscriber sending the data by identifying the modem 113 through which the data was received. For each terminal, the hub controller supplies downstream signaling data to a QPSK modem 113 connected to the line 34 going to that terminal 100. The QPSK modem 113 modulates the downstream signaling data and outputs the data in the channel range assigned for downstream signaling data. The QPSK modem 113 supplies the downstream signaling data channel, containing the modulated downstream signaling

messages, to the splitter/combiner 111. The splitter/combiner 111 in turn frequency multiplexes the modulated downstream signaling channel information together with all other downstream signals and transmits the resultant multiplex over the subscriber's telephone loop 34, for transport to the connected terminal 100.

Using signaling through the modems 113, the hub controller 115 responds to selection signals from end users to control the switch 109 to supply selected programs over each subscriber's telephone loop 34. The hub controller 115 may also supply information needed to enable decoding of the digital signals back to the terminals 100 through the QPSK modems 113.

The splitter/combiner 111 is a diplex filter network for combining signals in certain frequency channels together and transmitting those signals downstream over the local loop 34. The diplex filter network also receives certain frequency channels in the upstream direction and separates out those frequency channels. More specifically, each splitter/combiner 111 receives downstream POTS signals from one of the lines connected to the CO 45, broadband signals from one output port of the switch 109 and downstream QPSK modulated signaling information from one of the QPSK modems 113 and frequency multiplexes those signals together (e.g. in the manner shown in Figure 7A) for downstream transmission over the connected telephone loop 34. From the loop 34, the splitter/combiner 111 receives upstream POTS telephone signals and upstream QPSK signaling information, in the respectively assigned frequency channels. The splitter/combiner 111 separates out the upstream telephone signals and the upstream QPSK signals. The splitter/combiner 111 supplies the upstream telephone signals over the line to the CO 45 and supplies the upstream QPSK signals to the associated QPSK modem 113.

Figure 10 shows the elements of the terminal 100 and the other components in one of the living units 75. As shown, the telephone loop 34 from the landline interface system 32 connects to a NID 35. The NID provides two-way coupling of the POTS signals between the line 34 and the customer premises telephone equipment 41.

The NID 35 comprises a POTS splitter/combiner. The POTS splitter/combiner is another diplex filter network. This filter network passes downstream signals in the telephone frequency band (e.g. 300 hz to 4 kHz) through standard telephone wiring in the living unit to one or more POTS telephones 41. The POTS splitter/combiner also receives telephone frequency band (e.g. 300 hz to 4 kHz) signals from the telephone(s) 41. In the upstream direction, the splitter/combiner in NID 35 frequency multiplexes the upstream telephone frequency signals together with any other upstream information (e.g. the QPSK upstream signaling channel from the terminal 100) for transmission upstream over loop 34 to the combiner/splitter 111 serving this customer's line in the landline interface system 32.

The POTS splitter/combiner in the NID 35 passes downstream signals in frequency ranges above the maximum telephone frequency used (e.g. above 4 kHz) over twisted wire pair, coaxial cable or the like to the another splitter/combiner 191 within the terminal 100. The splitter/combiner 191 is another diplex filter network. The splitter/combiner 191 couples the downstream broadband channel, containing the ADSL line code information for a selected broadband broadcast program to a demodulator 192. The demodulator is an ADSL-like demodulator, in that it demodulates the particular type of modulation or line code used by the modulators 107 (e.g. CAP or DMT). The demodulator 192 recovers the single program transport stream (e.g at 6+ Mbits/s) from the analog broadband channel on the loop 34 and supplies

the recovered transport stream to an MPEG II decoder 193. The MPEG II decoder 193 preferably is a single chip decoder designed to convert a single program input stream into an NTSC format analog video signal.

The MPEG II decoder may supply the NTSC signal as a baseband feed to the television 99. Preferably, the terminal includes a modulator 194, for modulating the NTSC signal from the decoder 193 onto either channel 3 or channel 4. A coaxial cable or the like connects the output of the modulator 194 to the cable or antenna input of a standard television set 99. To view received programming, the user turns on the television set 99 and tunes that set to the channel (3 or 4) that is output by the modulator 194. The television processes the channel 3 or 4 video signal to produce an audio/video presentation of the broadband information to the user.

The installation in the living unit also includes a remote control 85. In response to user activation, the remote control 85 transmits infrared (IR) data signals to an IR receiver 195 in the terminal 100. The IR receiver 195 decodes received IR signals and supplies received data messages to a controller 196. In response, the controller supplies appropriate data messages to a QPSK modem 197. The modem 197 in turn QPSK modulates the messages for transmission to the landline interface system 32. The modem 197 supplies modulated information, in the upstream channel frequency range, to the splitter/combiner 191. The splitter/combiner 191 sends the signaling channel frequency information upstream to the NID 35. The POTS splitter/combiner in the NID 35 frequency multiplexes the upstream signaling channel together with the upstream POTS information and applies the resultant upstream multiplex to the telephone loop 34 for transport over the loop to the splitter/combiner 111 connected to the subscriber's loop 34 within the landline interface system 32.

As discussed above, the downstream signals on the telephone loop 34 include POTS signals, downstream QPSK signaling messages and broadband information (see Figure 7A). In the living unit, the splitter/combiner in the NID 35 splits off the downstream POTS information and supplies that information as standard telephone signals to one or more telephones 41. The splitter/combiner in the NID 35 supplies the downstream signaling channel and the ADSL line code frequency channel from the loop 34 to splitter/combiner 191 in the terminal 100. The splitter/combiner 191 frequency demultiplexes the downstream signals and supplies the ADSL line code frequency channel to the demodulator 192. The splitter/combiner 191 supplies the downstream signaling frequency channel to the QPSK demodulator 197.

The QPSK demodulator 197 demodulates the downstream signaling channel and supplies packet data messages from that channel to the terminal controller 196 for further processing. The downstream messages, for example, may relate to information such as PID values needed to control the decoder 193 to decode a selected program.

It will be readily apparent that the demodulator and decoder utilized in the terminal 100 are relatively simple in that neither has to have selection capacity. The demodulator need not select from a plurality of broadcast channels, because that function is performed by the digital receivers 103 in the landline interface system 32. Similarly, the decoder need not operate at the full 27 Mbits/s rate and need not select one program from among several contained in the 27 Mbits/s rate stream, because those functions are performed by the Demux/Remux circuits 105 in the landline interface system 32. The cost of the terminals 100 therefore is relatively low; and replacement of a terminal 100, due to damage or theft, therefore is less expensive. Also, because of the lack of full internal selectivity, the

terminals 100 can not operate as stand-alone terminals, such as in the single residence installation $R_1$ shown in Figure 7. As a result, tenants should be less inclined to steal the terminals 100 when they leave the rental property or the landlord evicts the tenants.

It will be helpful in understanding the invention to consider an operation of the system, step by step, in providing a selected program for viewing on a user's television set. In operation, a user activates the remote control 85 to select a program (Figure 10). The IR receiver 195 supplies the input data message from control 85 to the controller 196. In response, the controller 196 formulates a program request message as packetized data. The controller 196 supplies that message to the QPSK modem 197 for upstream transmission through the splitter/combiner 191, the NID 35 and the signaling channel on the telephone loop 34.

In the landline interface system (Figure 8), the splitter/combiner 111 connected to the subscriber's loop 34 supplies the upstream QPSK data signal to an associated one of the QPSK modems 113. The QPSK modem 113 demodulates the upstream signaling information and supplies the resultant data, in this case the program request message, to the hub controller 115.

The hub controller 115 may contain subscriber profile data and control access to at least some premium or pay-per-view channels based on the profile data. If so, the hub controller 115 determines if the requesting subscriber is authorized access to the requested program. If authorized, the hub controller 115 provides a control instruction to the switch 109. The instruction identifies the input port of the selected program and the output port connected to the line 34 to the terminal 100 from which the current request originated.

In response to the instruction from the hub controller 115, the switch 109 connects the broadband

modulated analog signal from the identified input port (and connected modulator 107) to the splitter/combiner 111 coupled to the subscriber's line 34. As discussed above, the broadband signal carries a digital transport stream for a single selected program modulated using an ADSL-like modulation technique (e.g. CAP or DMT) in a frequency range assigned for broadband downstream transport over subscribers lines. The splitter/combiner 111 frequency multiplexes the broadband signal output by the switch 109 with any downstream POTS and QPSK signaling information and transmits the multiplexed signals over the particular subscriber's line 34.

In the living unit (Figure 10), the splitter/combiner in the NID 35 supplies the downstream signaling and the ADSL line code frequency channel from the loop 34 to splitter/combiner 191 in the terminal 100. The splitter/combiner 191 frequency demultiplexes the downstream signals. The splitter/combiner 191 supplies the downstream signaling frequency channel to the QPSK demodulator 197. The splitter/combiner 191 couples the downstream broadband channel, containing the ADSL line code information for a selected broadband broadcast program, to the demodulator 192.

The demodulator 192 recovers the single program transport stream (e.g at 6+ Mbits/s) from the analog broadband channel on the loop 34 and supplies the recovered transport stream to the MPEG II decoder 193. The MPEG II decoder 193 decompresses the information from the packets in the single program stream and converts the uncompressed digitized digital data into an NTSC format analog video signal.

The terminal controller 196 supplies necessary information, if any, to the MPEG II decoder 193 to control operation thereof. The decoding process executed by the decoder 192 requires identification of the PID values for the transport packets containing the audio,

video and data (if any) for the selected program. The terminal controller 196 may supply a program number (PN), which the decoder 193 uses to access information from the program association table (PID 0) and program map table to identify the PIDs for the selected program. Preferably, the controller 196 supplies the actual PID values, either from memory or received from the hub controller 115 via the downstream QPSK signaling communication.

The modulator 194 modulates the NTSC signal from the decoder 193 onto either channel 3 or channel 4 and supplies the modulated channel signal to the television set 99. The television set 99 processes the channel 3 or 4 video signal to produce an audio/video presentation of the selected program to the user.

The above discussed preferred embodiment relies on twisted pair wiring. In many multi-unit complexes, such wiring already exists, and new wiring to each individual living unit is unnecessary. Figures 11 and 12 disclose an alternate embodiment of the shared receiving system or the present invention, which utilizes coaxial cable wiring from the landline interface to the individual living units. In some respects, the embodiment of Figures 11 and 12 corresponds to the embodiment of Figures 7 and 8, and as such, like elements are referenced by the same index numerals.

The shared receiving system $R_{2s}$ includes at least one and typically a plurality of directional microwave antennae, aimed at one of the transmitters TX1 to TXN. In the illustrated implementation, the system $R_{2s}$ includes the same number of microwave receiving antennae $31_1$ to $31_N$ as there are transmitters TX1 to TXN serving the region, with one of the microwave receiving antennae $31_1$ to $31_N$ aimed at each of the transmitters TX1 to TXN, as in the earlier embodiment.

Signals from the microwave receiving antennae $31_1$ to $31_N$ all go to shared wireless signal processing circuitry 33. The shared wireless signal processing circuitry 33 processes the signals from the microwave receiving antennae $31_1$ to $31_N$ to produce a single high quality RF spectrum signal in at least a portion of the 50-450 MHz range from the microwave transmissions, exactly as discussed above. The shared wireless signal processing circuitry 33 outputs the processed channel signals through a coaxial cable or the like to a landline interface system 232. The landline interface system 232 may also provide a connection to a node 55 of a landline based broadband network, such as a switched digital video (SDV) network. The landline interface system processes all received broadcast signals from the wireless transmission (and from the SDV node if so connected) to derive separate analog video signals for each individual broadcast program and supplies selected signals over the coaxial drop cables 234. A separate drop cable 234 couples the landline interface system 232 to each of the individual living units 275.

In each living unit 275, the coaxial drop cable 234 connects directly to the television set 99. As discussed more fully below, the landline interface system 232 decodes a selected program from the digital broadcast information and supplies that program as an analog television channel signal over the coaxial cable 34. The television 99 receives and processes the analog channel signal in the normal manner to provide a typical audio/video television type presentation of selected programming to a viewer.

The added equipment in the living unit, in this embodiment, includes only a remote control device 85, an infrared (IR) receiver 295 processing the signals from the remote control, and a QPSK modem 297 responsive to data from the IR receiver 295 for transmitting selection

requests upstream over the coaxial cable 234 to the landline interface system 232.

One example of a frequency channelization for use on a coaxial drop cable 234 appears in Figure 11A. Although it would be possible to transport POTS service signals over the coaxial cables, it has been assumed that separate twisted wire pairs (not shown) carry those signals. Accordingly, in the example illustrated in Figure 11A, there are no POTS signals on the coaxial cable. A standard television channel somewhere above the 50 Mhz level, e.g. channel 3 (61.25 to 65.75 MHz), carries a standard modulated NTSC signal. If one or more additional televisions in the same living unit receive service through the same cable, each such additional television would receive a higher assigned channel slot on coaxial cable 234. For example, a second television would receive programming via television channel 4 (67.25 to 71.75 MHz) shown in dotted lines in Figure 11A.

The frequency allocation on the loop 234 also provides at least a one-way (upstream) signaling channel. In the presently preferred example illustrated in Figure 11A, a two-way signaling channel is provided in some convenient frequency range below the frequencies used for video transport, i.e. below the 50 MHz level. As in the earlier embodiment, the signaling channel carries packetized data communications using QPSK modulation. Persons skilled in the art will recognize that a variety of frequency values can be used for the various channels shown in Figure 11A.

Figure 12 illustrates the functional elements of an exemplary implementation of the landline interface system 232. For simplicity of discussion, it again is assumed that the landline interface system 232 receives only broadcast signals from the wireless broadband transmission system of Figure 6. The illustrated system 232 therefore includes processing elements to derive a

digital transport stream for each wireless broadcast program. Additional processing circuitry (not shown) would be provided to derive signals for programs supplied through the SDV node 55 (Figure 11).

A splitter 101 receives the combined spectrum signal in the 50-450 MHz range via the coaxial cable, directly from a downconverter in a single receiving antenna installation or from the shared wireless signal processing circuitry 33 in a multiple receiving antenna implementation such as that shown in Figure 11. The splitter supplies the combined spectrum signal to each of a plurality of digital receivers 103. The digital receivers 103 in turn recover the digital transport stream (e.g. 27 Mbits/s payload only) from each of the broadcast channels and supply those signals to associated Demux/Remux circuits 105. Each digital receiver 103 supplies a 27 Mbits/s transport stream, containing a plurality of programs to a digital signal processor identified as a 'Demux/Remux' circuit 105. The Demux/Remux circuit 105 separates out a digital stream for each individual program carried in the broadcast transport stream. The splitter 101, the digital receivers 103 and the Demux/Remux circuits 105 shown in Figure 11 are identical to those discussed above with regard to Figures 8 and 9.

Each output of the Demux/Remux circuits 105 consists of MPEG II transport packets containing the video, audio and data (if any) for one broadcast program encoded in conformance with MPEG II syntax. The Demux/Remux circuits 105 supply each individual single program transport stream to an MPEG II compliant decoder 293. The decoders 293 are substantially similar to the decoders 193 included in the terminals in the earlier embodiment, except that the decoders 293 all are controlled directly by the single hub controller 215. Each MPEG II decoder 293 decompresses the information

from the packets in a single program transport stream and converts the uncompressed digitized digital data into an NTSC format baseband analog video signal.

Each decoder 293 outputs an NTSC baseband signal to one input port of a switch 209. As such, the switch 209 receives an analog signal for each of the broadcast programs received by the landline interface system 232. Assume for example that the wireless broadcast system has licenses for 30 channels in the relevant portion of the UHF microwave range and encodes and multiplexes 4 programs for transport in each licensed channel. The landline interface system 232 therefore includes 30 operative digital receivers 103 and 30 operative Demux/Remux circuits 105. The landline interface system 232 includes 120 (4x30) operative decoders 293 supplying 120 separate analog program signals to the input ports of the switch 209. Additional sets of digital receivers, Demux/Remux circuits and decoders may be provided as spares, in a manner similar to the earlier embodiment.

The switch 209 has one output port for each television independently serviced by the system 232. Assume for simplicity that each living unit has one television set 99. The switch 209 has output ports going to analog NTSC modulators, typically operating at channel 3. There is one channel 3 modulator 294 and one splitter/combiner 211 for each coaxial drop cable 234. The modulated signal output by the each modulator 294 goes through a splitter/combiner 211 to one of the coaxial cables 234. Each splitter/combiner includes an appropriate directional coupler and appropriate filters to route the modulated television signal, e.g. channel 3, through from the switch 209 to the connected coaxial cable 234 in the downstream direction. The coupler may also couple higher frequency channel signals, e.g. channel 4 and higher, from separate modulators coupled to

the switch, to provide additional services to additional televisions in the same living units.

The switch 209 can connect a single input port to a single output port, if only one subscriber requests a particular program. The switch 209 also has multi-point connection capability. This means that the switch 209 can connect any 1 input port to a plurality or all of its output ports, for example if a large number of subscribers request the same program at the same time.

As noted above, a signaling channel is provided over each subscriber's coaxial drop cable 234. Although other modulation techniques and/or channelizations could be used, the presently preferred embodiment utilizes QPSK modems 213 operating in a frequency band below 50 MHz, in a manner similar to signaling communications utilized on cable television networks. In such an implementation, the QPSK modems provide a two-way data signaling capability between the living units and the hub controller 215 in the landline interface system 232.

Each QPSK modem 213 connects to one of the coaxial cables through an associated one of the splitter/combiner units 211. Each QPSK modem 213 receives upstream signaling from the line 234 via the splitter/combiner 211, demodulates the received signaling data and supplies the data through an appropriate interface to the hub controller 215. The hub controller 215 supplies downstream signaling data (if any) to a QPSK modem 213. The QPSK modem modulates the downstream signaling data and outputs the data in the channel range assigned for signaling data. The QPSK modem 213 supplies the downstream signaling, containing the modulated downstream signaling messages, to the splitter/combiner 211. The splitter/combiner 211 in turn frequency multiplexes the modulated downstream signaling information together with all other downstream signals and transmits the resultant multiplex over the subscriber's coaxial drop cable 234.

Using upstream signaling through the modems 213, the hub controller 215 responds to selection signals from end users to control the switch 209 to supply selected programs over each subscriber's coaxial drop cable 234.

It will be readily apparent that the equipment in the living units in the second embodiment is even simpler than that in the earlier embodiment. The living unit equipment includes the subscriber's television 99 and only the remote control 85, the IR receiver 295 and the QPSK modem 297. The cost of such limited equipment is correspondingly lower, and replacement due to damage or theft by rental property tenants is less expensive. Also, because of the lack of any demodulator or decoder in the living unit, tenants should be less inclined to steal the equipment when they leave the rental property or the landlord evicts the tenants.

To assist in understanding the invention, a description of a step by step operation of the embodiment of Figures 11 and 12 in providing a selected program for viewing on a user's television is set forth below.

In operation, a user activates the remote control 85 to select a program. The IR receiver 295 (Figure 11) supplies the input data message from the remote control to the QPSK modem 297, for upstream transmission through the signaling channel on the subscriber's coaxial drop cable 234. In the landline interface system 232 (Figure 12), the splitter/combiner 211 connected to the subscriber's cable 234 supplies the upstream QPSK data signal to an associated one of the QPSK modems 213. The QPSK modem demodulates the upstream information from the signaling channel and supplies the resultant data, in this case the program request message, to the hub controller 215.

The hub controller 215 may contain subscriber profile data and control access to at least some premium or pay-per-view channels based on the profile data. If

so, the hub controller determines if the requesting subscriber is authorized access to the requested program. If authorized, the hub controller 215 provides a control instruction to the switch 209. The instruction identifies the input port of the selected program and the output port connected to the modulator 294 serving the requesting subscriber.

In response to the instruction from the hub controller 215, the switch 209 connects the NTSC baseband signal from the identified input port (and the connected MPEG II decoder 293) to the modulator 294. The modulator 294 in turn outputs the signal for the selected program, now modulated on the channel used by the subscriber's television 99, to the splitter/combiner 211 coupled to the subscriber's drop cable 234.

In this implementation, the broadband signal coupled downstream to the cable 234 is in a standard channel format compatible with television set 99. The television 99 receives and processes the analog channel signal via the coaxial cable 234 in the normal manner, to provide a television type audio/video presentation of the selected programming to a viewer.

In the embodiment of Figure 7, each twisted wire pair transports a modulated broadband signal containing a digital transport stream for a single program. To provide service to two televisions in one living unit requires two loops 34 going to the one living unit. For simplicity, the above discussion of the embodiment of Figures 11 and 12 concentrated on transmission of a single program over the coaxial cable drop 234 going to each living unit. However, the coaxial cable drops have a much broader bandwidth and can carry a variety of other information. Of particular note, one coaxial cable 234 can carry two, three or more video channels to provide services to additional television sets in each living unit. For each drop providing a second channel, for

example, an additional modulator operating in a higher frequency channel (e.g. channel 4) would connect to another output port of the switch 209. The output of the second modulator would be coupled through the splitter/combiner 211 to the same coaxial cable 234 serving the one living unit. As a result, two separate channels on the cable would carry separately switched programming from the landline interface units 232 to two televisions 99 in the one living unit.

The above detailed description has concentrated on the preferred embodiments of the present invention. Those skilled in the art will recognize that each embodiment may be subject to a number of variations. For example, certain functions of the shared wireless signal processing circuitry and the landline interface may be combined into a single hub installation. As another example, in the coaxial cable installation, the NTSC modulators may be placed upstream of the switch, and the switch would route modulated NTSC signals (e.g. at channel 3 or 4 frequencies). Such an installation would utilize one modulator for each program, instead of one modulator for each coaxial cable, as in the embodiment illustrated in Figure 12. Also, other types of receivers and/or demultiplexers would be used to derive the separate digital program streams from signals from broadband networks using other types of channelization and/or digital multiplexing.

Also, the above discussion has concentrated on the preferred embodiment which broadcasts video programming. It should be noted, however, that the system may transport other types of programming, such as audio, data and/or telemetry.

While this invention has been described in connection with what is presently considered to be the preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiments,

but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

WE CLAIM:

1. A communication system receiving a plurality of multiplexed digitized information signals relating to a plurality of programs, said communication system comprising:

means for processing the multiplexed digitized information signals relating to the plurality of programs to derive separate program signals, each program signal containing information relating to a single one of the plurality of programs;

a plurality of lines, each line coupled to a broadband output device;

a switch, coupled between the means for processing the multiplexed digitized information signals and the plurality of lines, for routing selected ones of the program signals; and

a controller controlling the routing by the switch in response to program requests received via the plurality of lines.

2. A communication system as in claim 1, wherein the plurality of multiplexed digitized information signals comprise a plurality of multiplexed channels, each channel carrying a digital transport stream containing multiplexed digitized information relating to a group of the programs, and the means for processing the multiplexed digitized information signals comprises:

a plurality of receivers, one receiver for each of the plurality of multiplexed channels, wherein each receiver processes a different one of the multiplexed channels to recover the digital transport stream therefrom; and

demultiplexer means for demultiplexing each recovered digital transport stream, to thereby derive separate digital program signals, each digital program

signal containing digitized information relating to a single one of the plurality of programs.

3. A communication system as in claim 2, wherein:

the means for processing the multiplexed digitized information signals further comprises modulators, each modulator modulating one of the separate digital program signals; and

the switch selectively routes the modulated digital program signals.

4. A communication system as in claim 3, wherein the lines are telephone loops, and the modulators modulate the digital program signals into a predetermined frequency range compatible with transport over telephone loops.

5. A communication system as in claim 4, wherein telephone loops comprise twisted wire pairs.

6. A communication system as in claim 4, wherein the system further comprises splitter/combiners, one splitter/combiner being coupled between an output port of the switch and each respective telephone loop for frequency division multiplexing a modulated signal from the switch output port together with downstream telephone signals from a telephone network for transport over the respective telephone loop and for frequency demultiplexing upstream signals received over the respective telephone loop to supply upstream telephone signals from the loop to the telephone network and to supply upstream control program request signals from the respective telephone loop to the controller.

7. A communication system as in claim 2, wherein:

the means for processing the multiplexed digitized information signals further comprises digital decoders, each digital decoder converting one of the separate digital program signals to a corresponding television signal; and

the switch selectively routes the television signals output by the digital decoders.

8. A communication system as in claim 7, further comprising television channel modulators for modulating television program signals into a predetermined television channel.

9. A communication system as in claim 8, wherein at least one of the television channel modulators is coupled between an output port of the switch and each of the plurality of lines.

10. A communication system as in claim 7, wherein each of the digital decoders comprises an MPEG decoder.

11. A communication system as in claim 2, wherein each of the receivers comprises:

a channel selector; and

a demodulator.

12. A communication system as in claim 11, wherein the channel selector comprises a frequency channel selector.

13. A communication system as in claim 11, wherein the demodulator comprises a QAM demodulator.

14. A communication system as in claim 11, wherein each of the receivers further comprises an adaptive delay equalizer.

15. A communication system as in claim 11, wherein each of the receivers further comprises forward error correction circuitry.

16. A communication system as in claim 1, wherein the plurality of multiplexed digitized information signals comprise a plurality of multiplexed wireless broadcast channels, said communication system further comprising at least one antenna receiving and supplying multiplexed wireless broadcast channels to the means for processing the digitized information signals.

17. A communication system as in claim 1, wherein at least some of the routing by the switch comprises point to multi-point routing.

18. A communication system as in claim 1, wherein the lines run to a plurality of living units.

19. A communication system, comprising:

a broadcast network broadcasting a plurality of multiplexed digitized information signals relating to a plurality of programs; and

a plurality of receiving systems receiving the plurality of multiplexed digitized information signals from the broadcast network;

wherein one of the receiving systems serves a plurality of living units, the one receiving system comprising:

(a) means for processing the multiplexed digitized information signals relating to the plurality of programs to derive separate

program signals, each program signal containing information relating to a single one of the plurality of programs;

(b) a plurality of lines, each line coupled to a broadband output device in one of a plurality of living units;

(c) a switch, coupled between the means for processing the multiplexed digitized information signals and the plurality of lines, for routing selected ones of the program signals; and

(d) a controller controlling the routing by the switch in response to program requests received via the plurality of lines.

20. A communication system as in claim 19, wherein the broadcast network comprises a headend system producing a signal containing multiplexed channels, each channel carrying a transport stream comprising multiplexed streams of digitized broadband information, each multiplexed stream consisting essentially of digitized information relating to one of the plurality of programs.

21. A communication system as in claim 20, wherein the broadcast network further comprises at least one broadband wireless transmitter for broadcasting the signal containing multiplexed channels into a service area.

22. A communication system as in claim 21, wherein the one receiving system further comprises at least one receiving antenna for receiving the wireless transmission of the signal containing multiplexed channels and supplying the received signal containing multiplexed

channels to the means for processing the multiplexed digitized information signals.

23. A communication system as in claim 22, wherein:

said at least one broadband wireless transmitter comprises a plurality of transmitters located at spaced apart sites transmitting said signal containing multiplexed channels so that areas of propagation from respective ones of the transmitters substantially overlap over each other in at least a major portion of a service area encompassing the receiving systems; and

the at least one receiving antenna comprises a directional antenna directed towards one of the transmitters.

24. A communication system as in claim 23, wherein:

the at least one antenna comprises at least two directional receiving antennae, each directional receiving antenna being directed to receive said signal from a different one of the transmitters; and

the one receiving system further comprises signal processing circuitry receiving a signal from each of the receiving antennae and in response thereto supplying a single optimized representation of said signal including multiplexed channels to the means for processing the multiplexed digitized information signals.

25. A communication system as in claim 21, wherein said at least one broadband wireless transmitter comprises a plurality of transmitters located at spaced apart sites transmitting said signal containing multiplexed channels so that areas of propagation from respective ones of the transmitters substantially overlap over each other in at least a major portion of a service area encompassing the receiving systems.

26. A system as in claim 20, wherein the headend comprises:

(1) a source of a first digital multiplexed data stream containing a plurality of packet streams, each packet stream carrying digitized data representing one of a first group of programs,

(2) a source of a second digital multiplexed data stream containing a plurality of packet streams, each packet stream carrying digitized data representing one of a second group of programs, and

(3) a modulation system modulating the first digital multiplexed data stream and the second digital multiplexed data stream into first and second channels, respectively.

27. A communication system as in claim 26, wherein at least one of the sources comprises:

a plurality of encoders responsive to analog audio and video information for producing packets of digitized, compressed audio and video data; and

a multiplexer multiplexing packets of digitized, compressed audio and video data from the plurality of encoders into one digital multiplexed data stream.

28. A communication system as in claim 26, wherein said modulation system comprises:

a first modulator for modulating the first digital multiplexed data stream into the first channel;

a second modulator for modulating the second digital multiplexed data stream into the second channel; and

a combiner combining output signals from the first and second modulators into a combined spectrum signal for broadcast.

29. A communication system as in claim 28, wherein each of the first and second modulators comprises a quadrature amplitude modulator.

30. A communication system as in claim 19, wherein the broadcast system comprises a landline broadband network.

31. A communication system comprising:

a headend comprising:

(1) a source of a first digital multiplexed data stream containing a first plurality of packet streams, each packet stream of the first plurality of packet streams carrying digitized data representing one of a first group of video programs,

(2) a source of a second digital multiplexed data stream containing a second plurality of packet streams, each packet stream of the second plurality of packet streams carrying digitized data representing one of a second group of video programs,

(3) a modulation system modulating the first digital multiplexed data stream and the second digital multiplexed data stream into first and second channels, respectively;

a plurality of wireless transmitters located at respective different sites in a service area, the transmitters simultaneously transmitting a combined wireless signal containing the first and second channels into overlapping portions of the service area; and

a plurality of receiver systems within the service area, at least one of the receiver systems serving a plurality of living units, said at least one of the receiver systems comprising:

(a) means for processing the combined wireless signal to derive separate program signals, each program signal containing

information relating to a single one of the video programs;

(b) a plurality of lines, each line coupled to a broadband output device in one of a plurality of living units;

(c) a switch coupled between the means for processing and the plurality of lines, for routing selected ones of the video program signals; and

(d) a controller controlling the routing by the switch in response to program requests received via the lines.

32. A communication system as in claim 31, wherein the means for processing comprises:

a first demodulator demodulating the first channel to recover the first transport stream;

a first demultiplexer separating out the first plurality of packet streams from the recovered first transport stream;

a second demodulator demodulating the second channel to recover the second transport stream; and

a second demultiplexer separating out the second plurality of packet streams from the recovered first transport stream.

33. A communication system as in claim 32, wherein the means for processing further comprises:

a first group of modulators, each modulator in the first group of modulators modulating one of the first plurality of packet streams from the recovered first transport stream; and

a second group of modulators, each modulator in the second group of modulators modulating one of the second plurality of packet streams from the recovered second transport stream.

34. A communication system as in claim 33, wherein the lines are telephone loops, and each of the modulators in the first and second groups of modulators modulate one packet stream into a predetermined frequency range compatible with transport over telephone loops.

35. A communication system as in claim 32, wherein the means for processing further comprises a plurality of digital decoders, each digital decoder coupled to one output of the demultiplexers for converting one packet stream to a corresponding television signal.

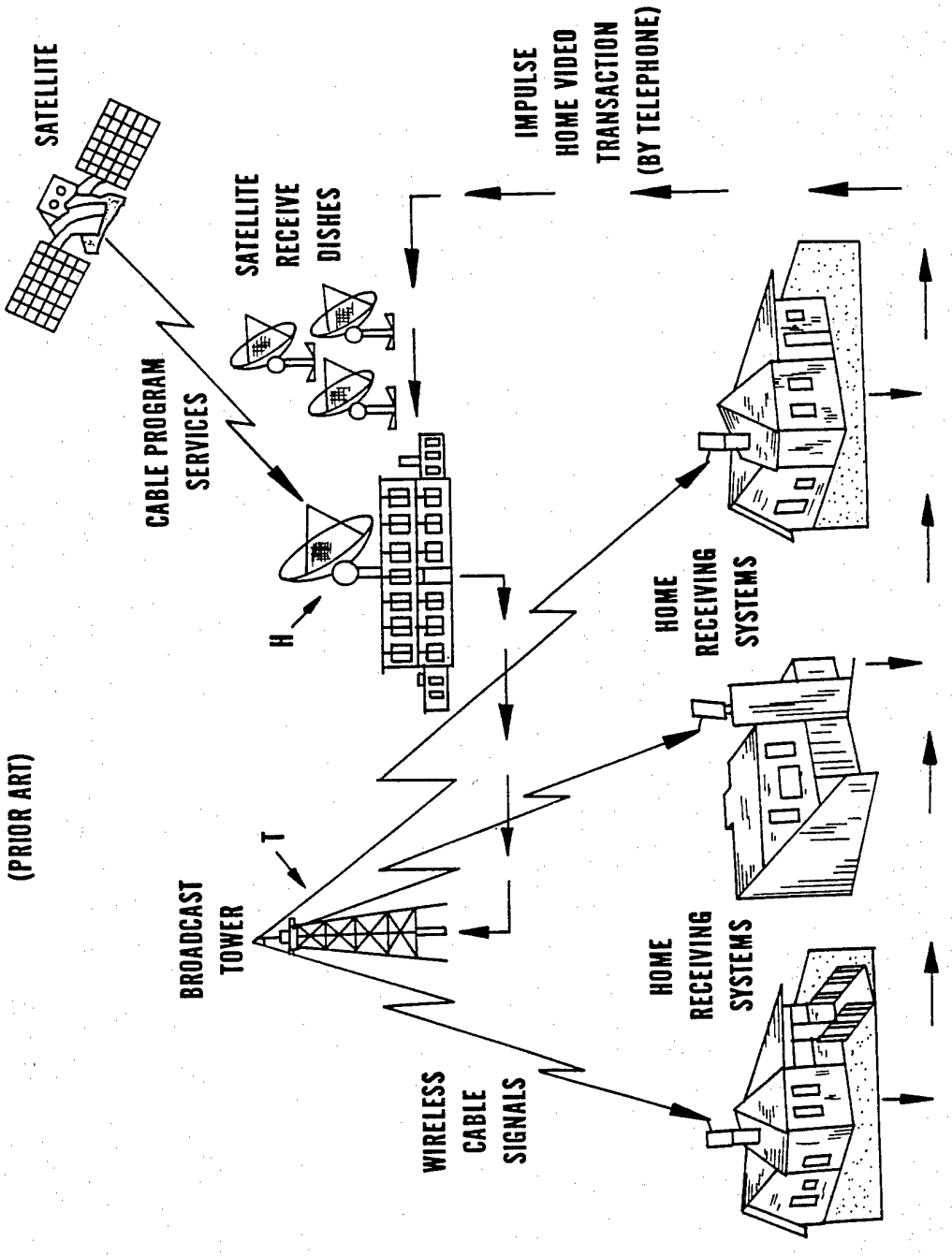



FIGURE 1
(PRIOR ART)

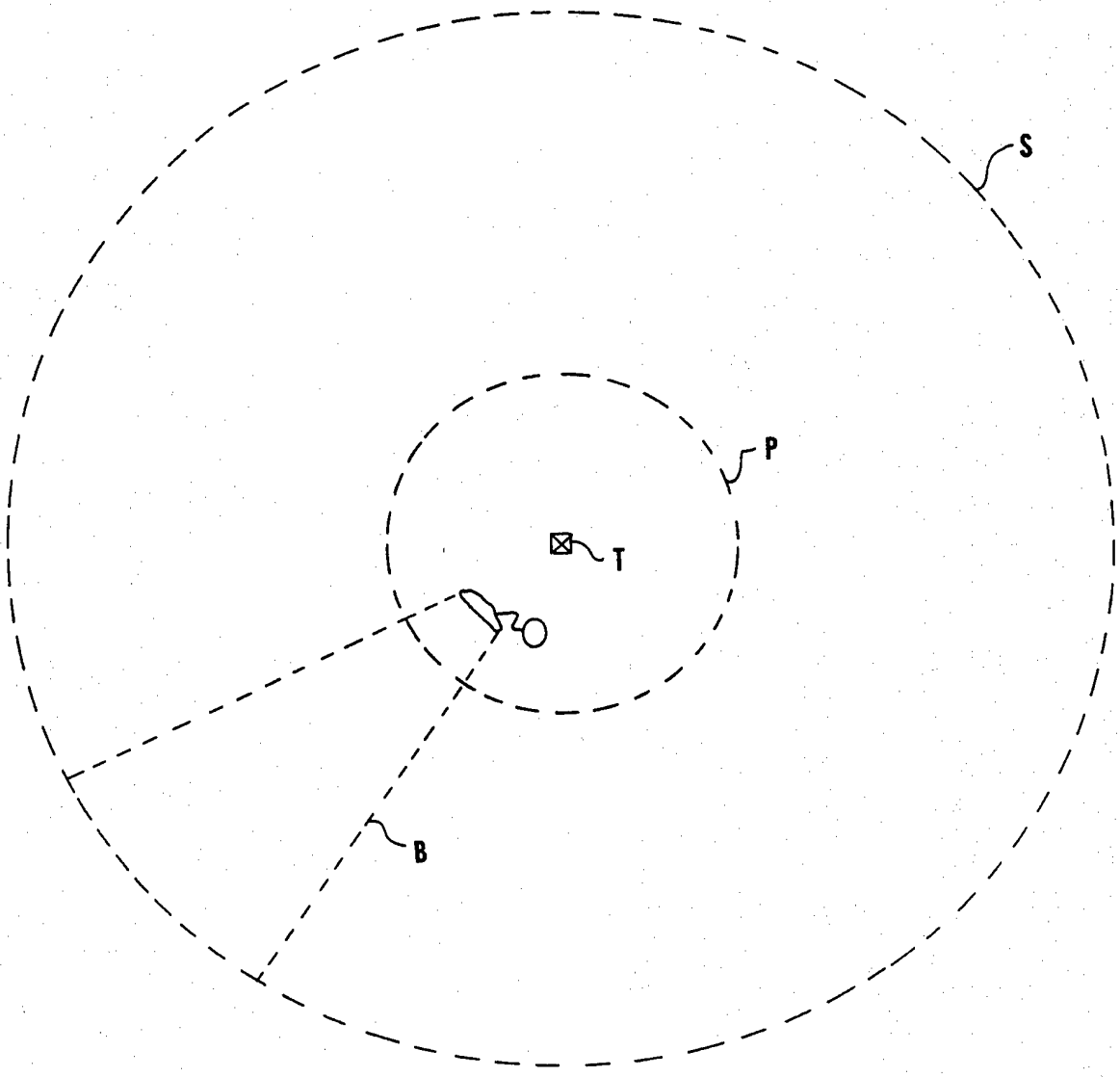



FIGURE 1A
(PRIOR ART)

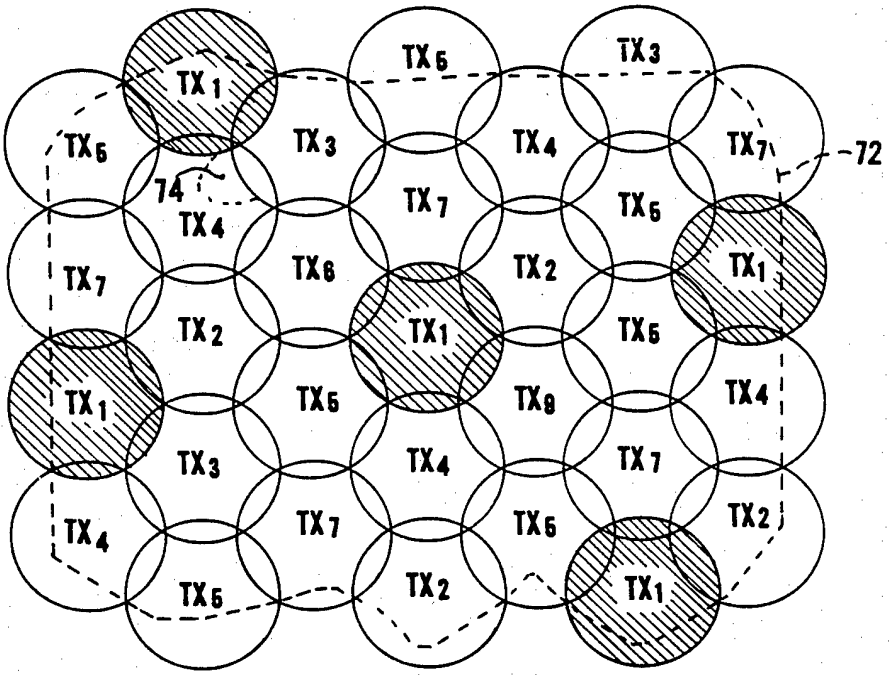



FIGURE 2
(PRIOR ART)

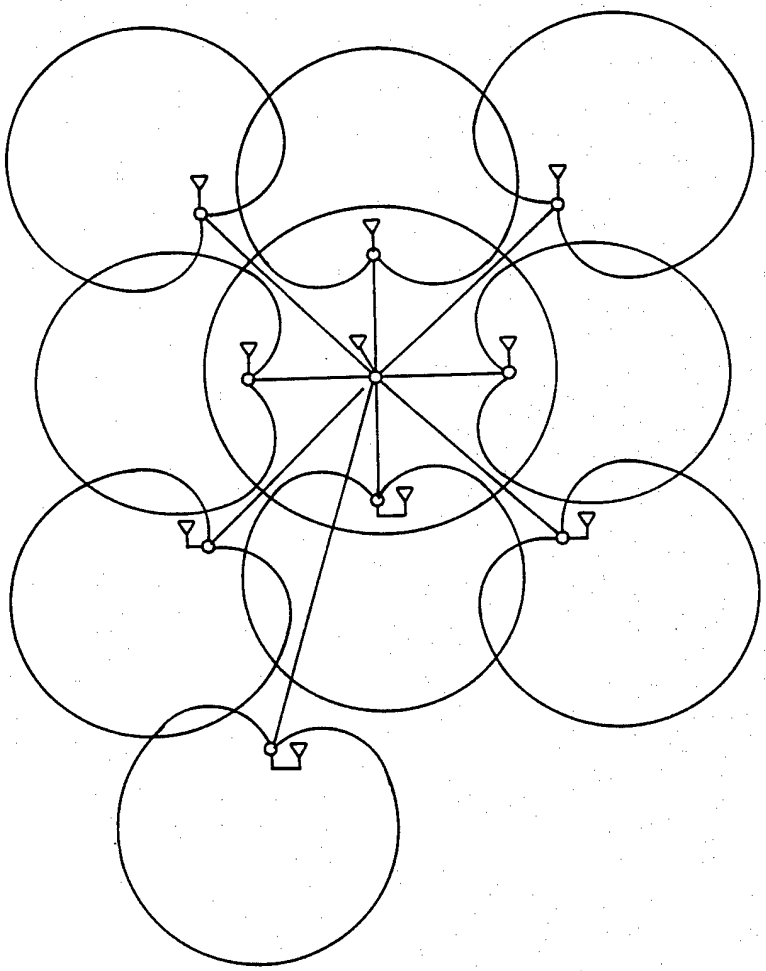


FIGURE 3
(PRIOR ART)

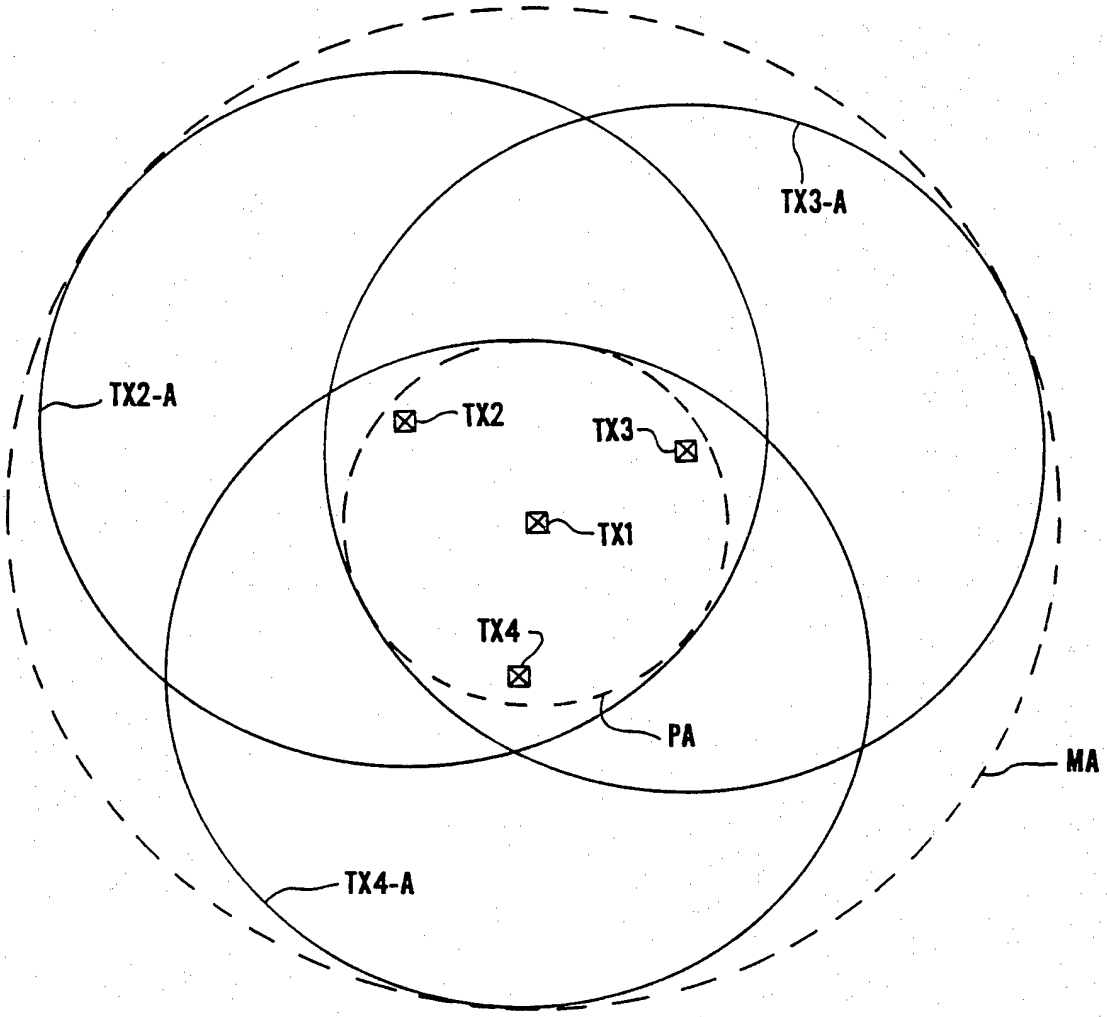



FIGURE 4

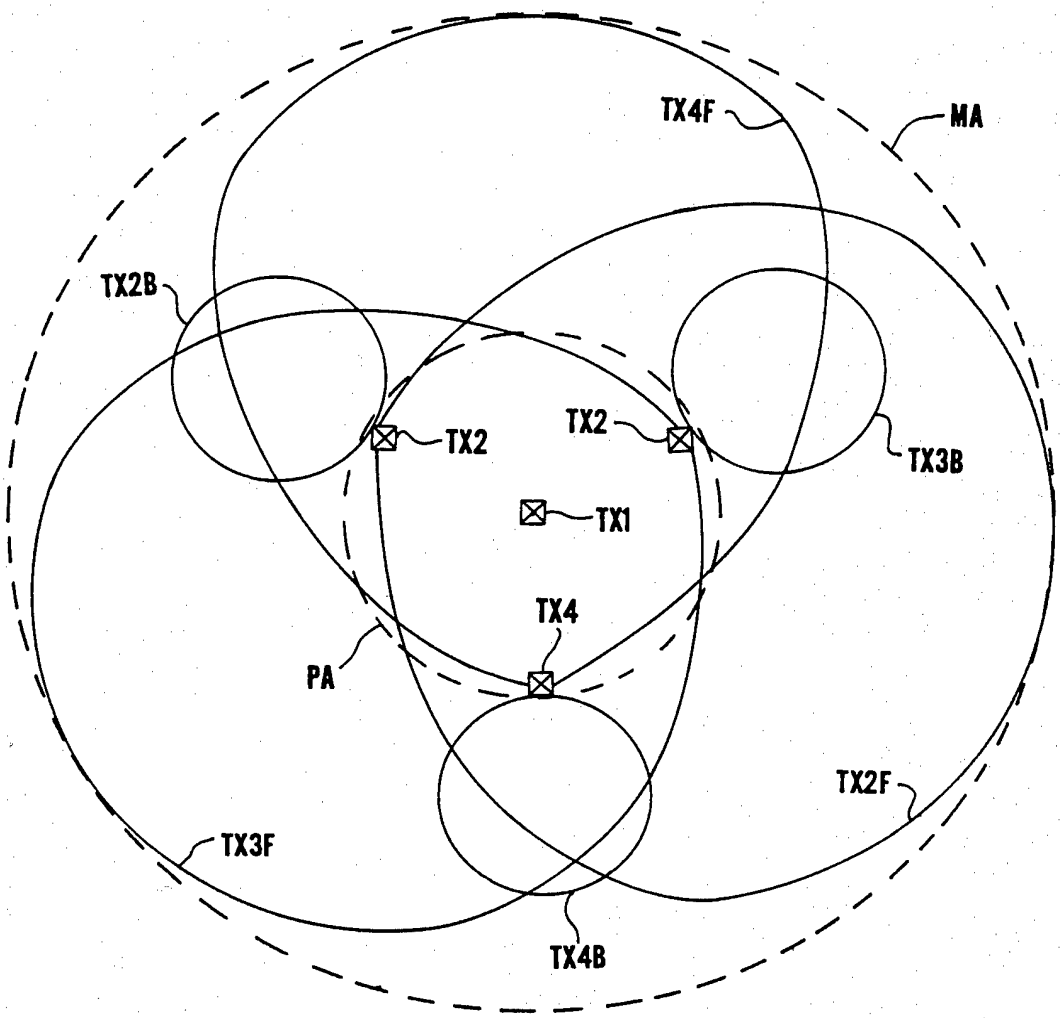



FIGURE 5

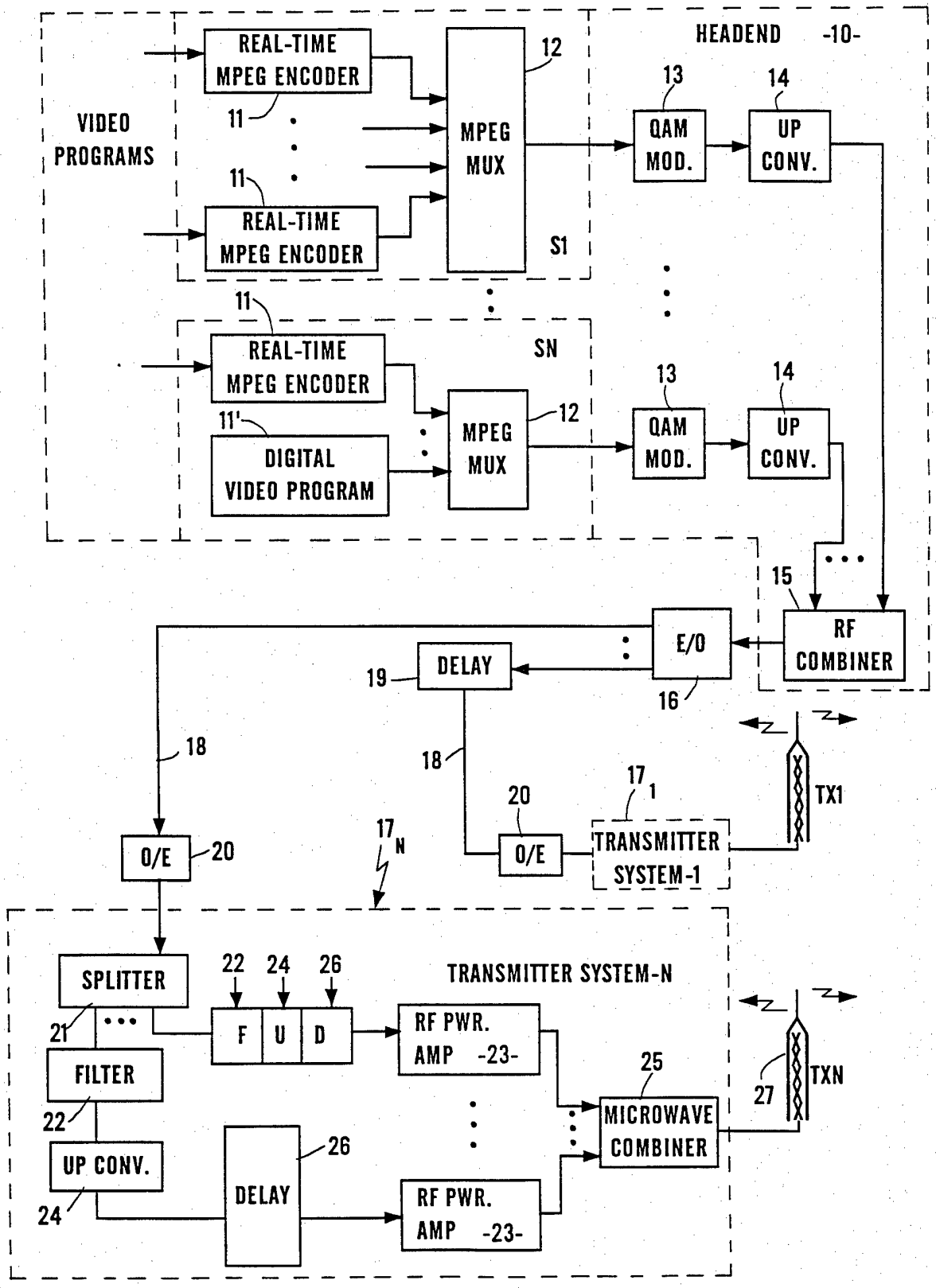

HEADEND -10-
VIDEO PROGRAMS
REAL-TIME MPEG ENCODER
11
REAL-TIME MPEG ENCODER
11
MPEG MUX
12
S1
QAM MOD.
13
UP CONV.
14
SN
REAL-TIME MPEG ENCODER
11
DIGITAL VIDEO PROGRAM
11'
MPEG MUX
12
QAM MOD.
13
UP CONV.
14
RF COMBINER
15
E/O
16
DELAY
19
18
18
O/E
20
O/E
20
17 1
TRANSMITTER SYSTEM-1
TX1
17 N
SPLITTER
21
FILTER
22
UP CONV.
24
22 24 26
F U D
DELAY
26
TRANSMITTER SYSTEM-N
RF PWR. AMP -23-
RF PWR. AMP -23-
MICROWAVE COMBINER
25
27
TXN

FIGURE 6

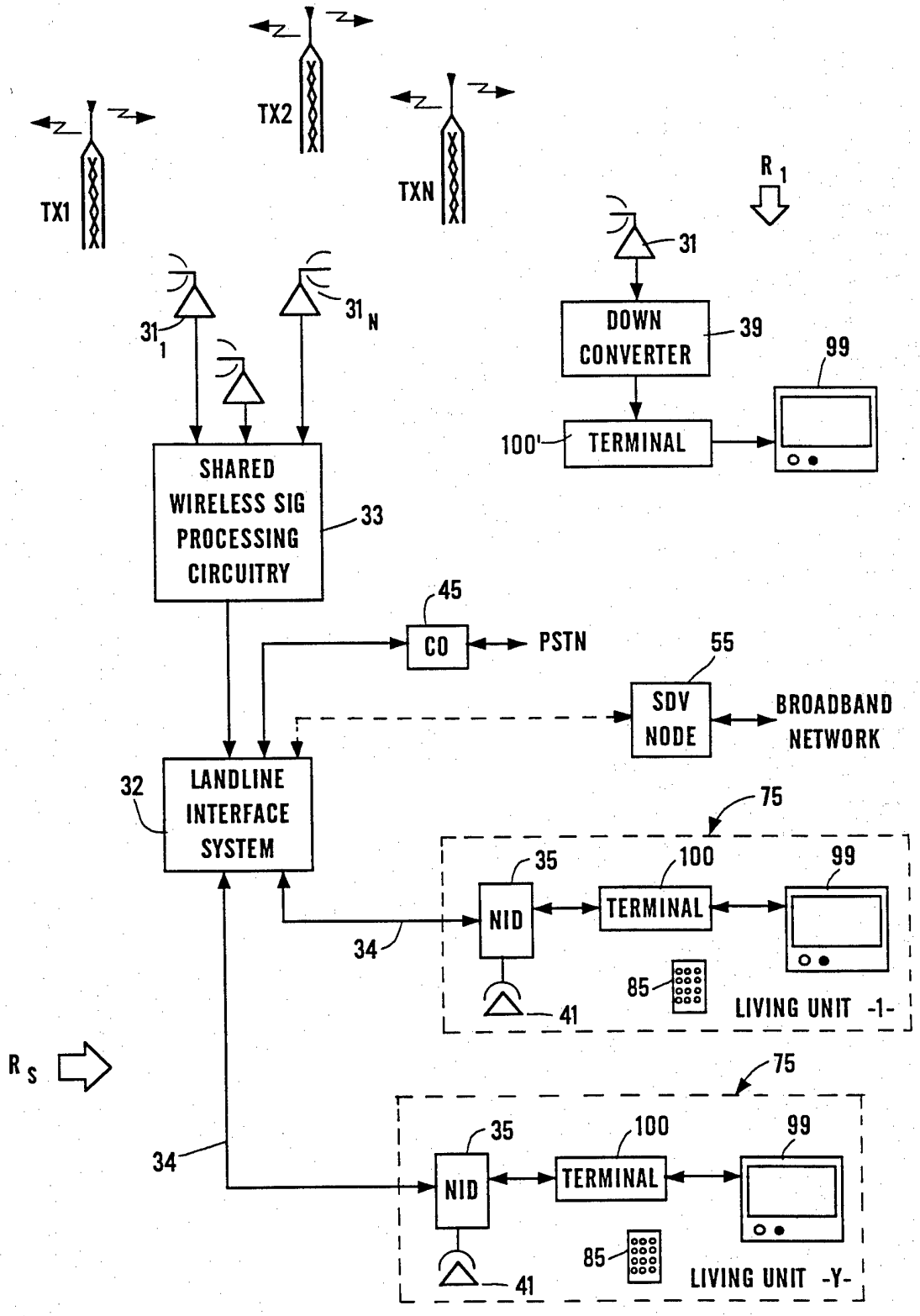

TX1
TX2
TXN
R 1
31
DOWN CONVERTER
39
99
100'
TERMINAL
31 1
31 N
SHARED WIRELESS SIG PROCESSING CIRCUITRY
33
45
CO
PSTN
55
SDV NODE
BROADBAND NETWORK
32
LANDLINE INTERFACE SYSTEM
75
35
100
99
NID
TERMINAL
34
85
41
LIVING UNIT -1-
R S
75
35
100
99
NID
TERMINAL
34
85
41
LIVING UNIT -Y-

FIGURE 7

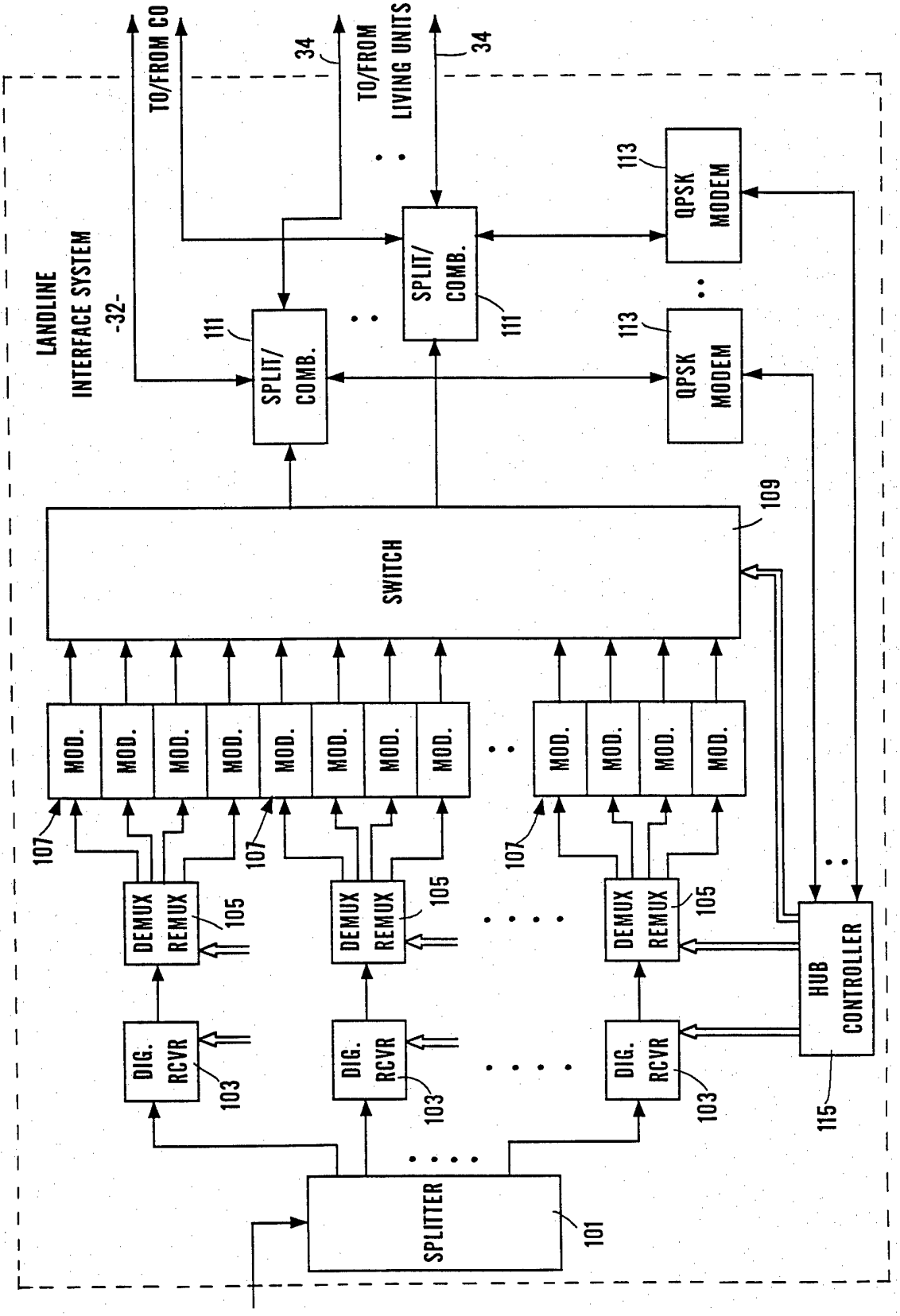
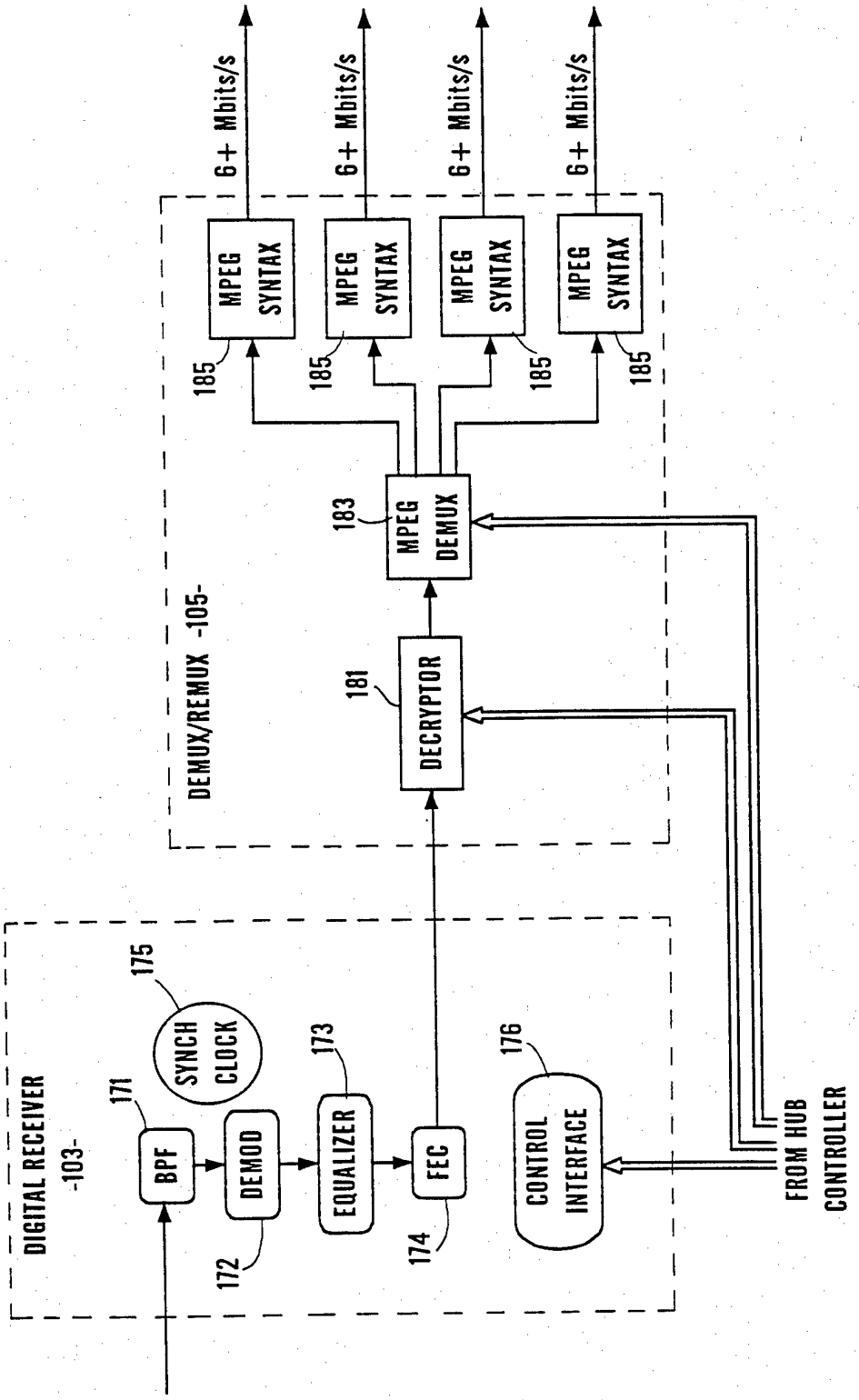

LANDLINE INTERFACE SYSTEM
-32-
TO/FROM CO
34
TO/FROM LIVING UNITS
34
SPLIT/ COMB.
111
SPLIT/ COMB.
111
QPSK MODEM
113
QPSK MODEM
113
SWITCH
109
MOD.
DEMUX REMUX
105
DIG. RCVR
103
107
HUB CONTROLLER
115
SPLITTER
101

FIGURE 8


DIGITAL RECEIVER
-103-
BPF
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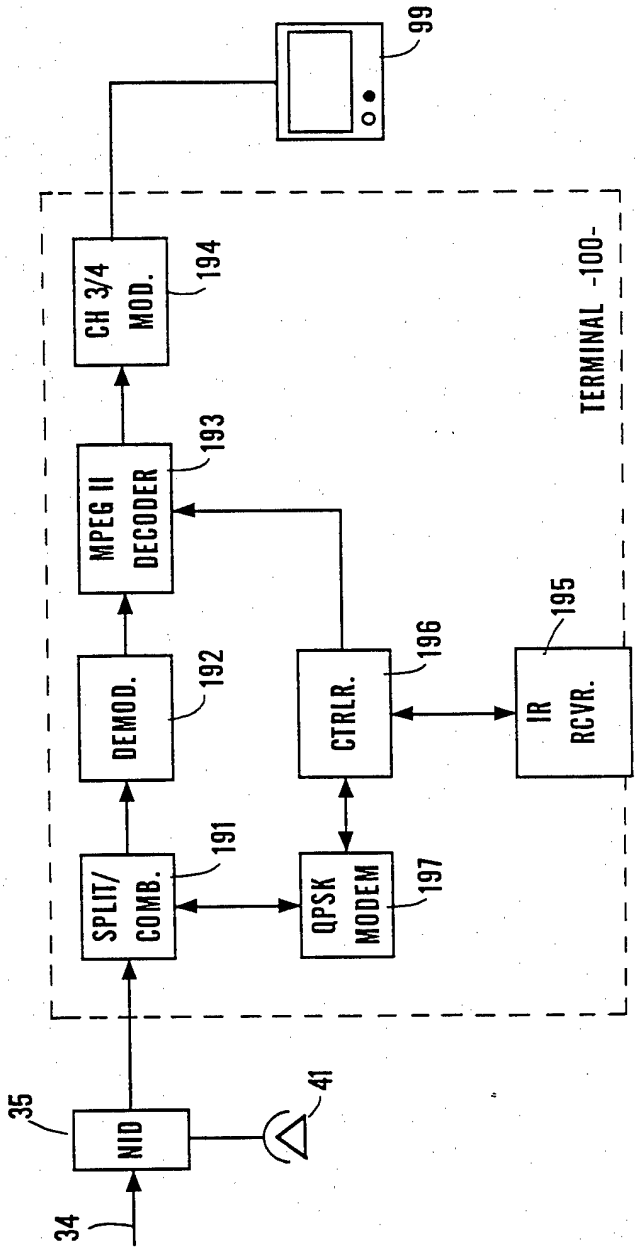
DEMOD
172
SYNCH CLOCK
175
EQUALIZER
173
FEC
174
CONTROL INTERFACE
176
FROM HUB CONTROLLER
DEMUX/REMUX -105-
DECRYPTOR
181
MPEG DEMUX
183
MPEG SYNTAX
185
6+ Mbits/s

FIGURE 9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MPEG II DECODER
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DEMOD.
192
CTRLR.
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IR RCVR.
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85
SPLIT/ COMB.
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QPSK MODEM
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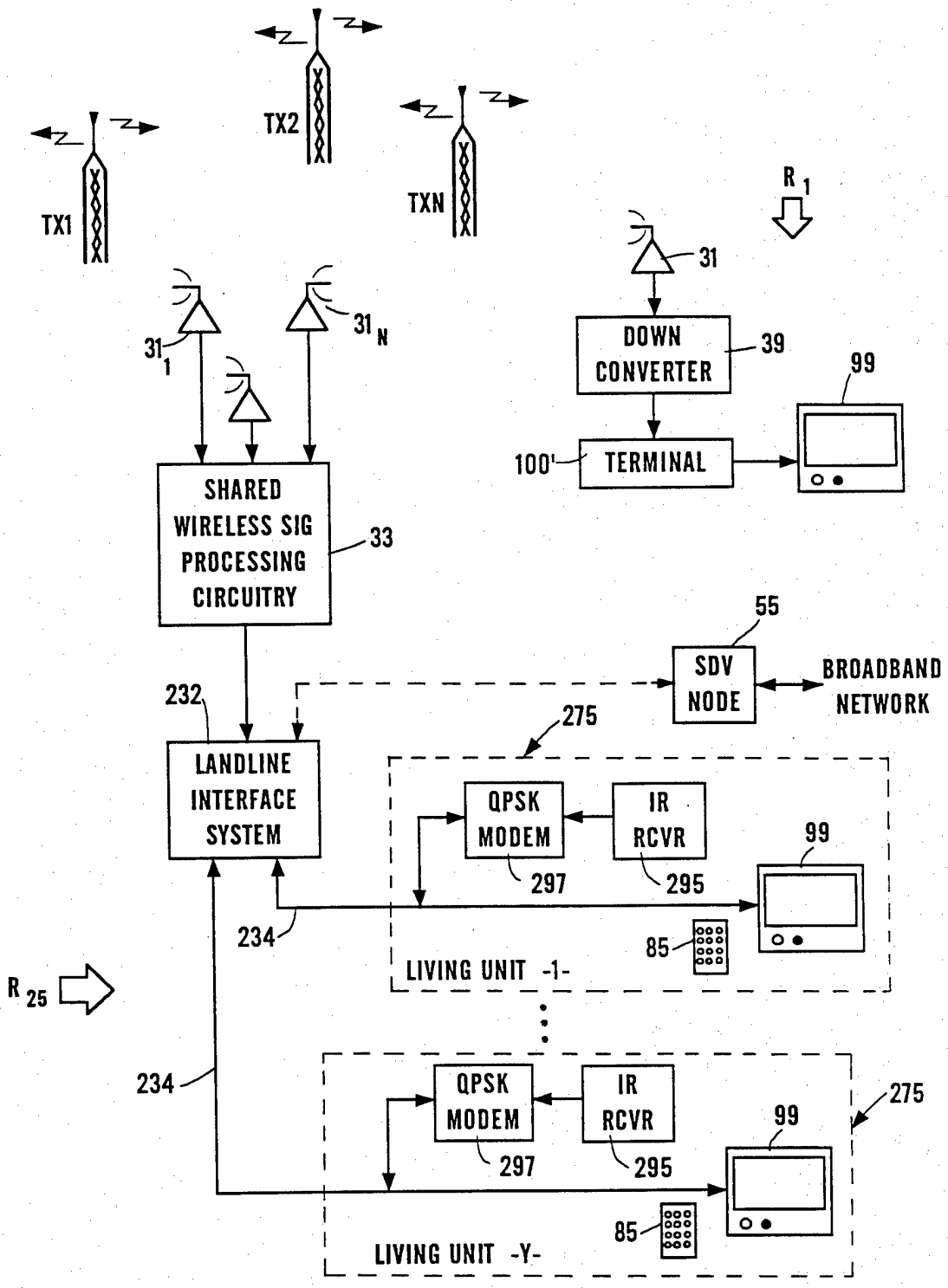
NID
35
41
34

FIGURE 10


TX1
TX2
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R 1
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DOWN CONVERTER
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99
100'
TERMINAL
31 1
31 N
SHARED WIRELESS SIG PROCESSING CIRCUITRY
33
55
SDV NODE
BROADBAND NETWORK
232
275
LANDLINE INTERFACE SYSTEM
QPSK MODEM
IR RCVR
297
295
99
234
85
LIVING UNIT -1-
R 25
234
QPSK MODEM
IR RCVR
297
295
99
275
85
LIVING UNIT -Y-

FIGURE 11

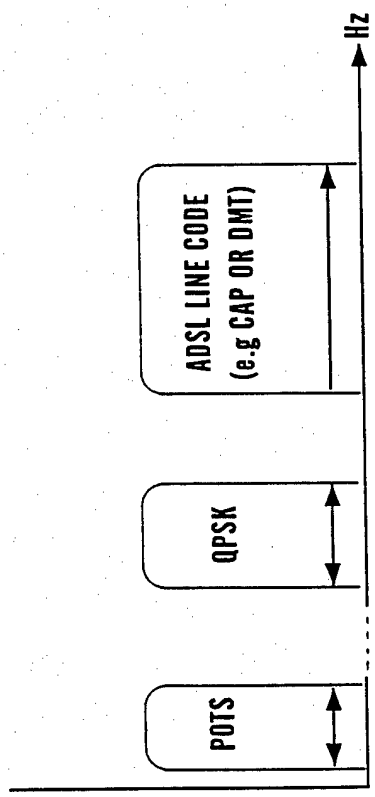



FIGURE 7A

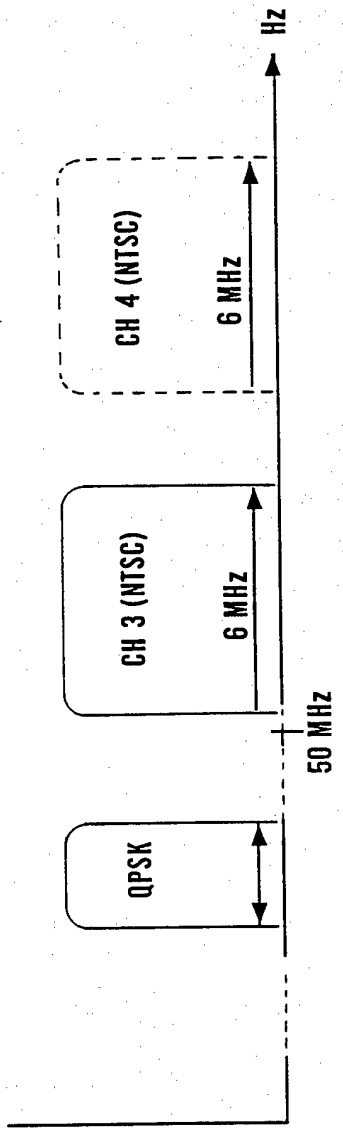
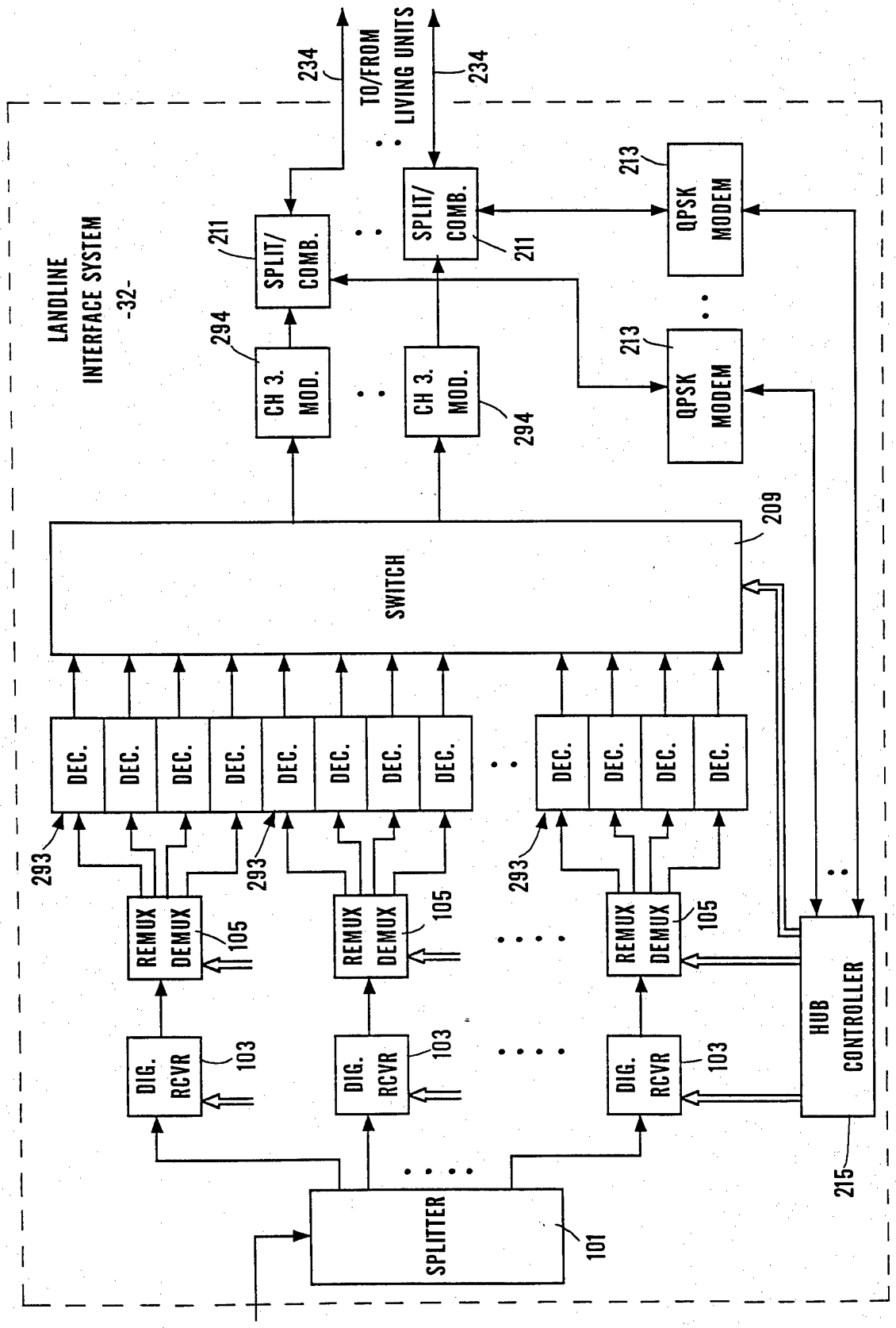



FIGURE 11A


LANDLINE
INTERFACE SYSTEM
-32-
TO/FROM
LIVING UNITS
234
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COMB.
211
SPLIT/
COMB.
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213
QPSK
MODEM
213
QPSK
MODEM
294
CH 3.
MOD.
CH 3.
MOD.
294
209
SWITCH
DEC.
293
REMUX
DEMUX
105
DIG.
RCVR
103
HUB
CONTROLLER
215
SPLITTER
101

FIGURE 12

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/03688

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :H04H 3/00
US CL :370/112, 73, 58.1, 58.2, 110.1; 455/3.1, 3.2, 3.3, 4.1, 4.2, 5.1, 6.1; 348/6, 7, 10
According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 370/112, 73, 58.1, 58.2, 110.1; 455/3.1, 3.2, 3.3, 4.1, 4.2, 5.1, 6.1; 348/6, 7, 10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | US, A, 5,410,343 (CODDINGTON ET AL) 25 April 1995, col. 6, lines 11-47, and Fig. 2. | 1, 16-21, 30 |
| Y | US, A, 5,231,494 (WACHOB) 27 July 1993, col. 3, line 65, to col. 4, line 12. | 1, 16-21, 30 |

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

| | | | |
|---|---|---|---|
| * | Special categories of cited documents: | "T" | later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention |
| "A" | document defining the general state of the art which is not considered to be part of particular relevance | "X" | document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone |
| "E" | earlier document published on or after the international filing date | "Y" | document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art |
| "L" | document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) | "&" | document member of the same patent family |
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| "P" | document published prior to the international filing date but later than the priority date claimed | | |

Date of the actual completion of the international search
21 MAY 1996

Date of mailing of the international search report
12 JUN 1996

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Authorized officer
CHAU T. NGUYEN
Telephone No. (703) 308-5340

Form PCT/ISA/210 (second sheet)(July 1992)★

# WO0040013

Publication Title:

SYSTEM AND METHOD FOR CUSTOMIZING PROGRAM GUIDE INFORMATION TO INCLUDE REMINDER ITEM OR LOCAL IDENTIFIER

Abstract:

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**PCT** WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(11) International Publication Number: **WO 00/40013**

(43) International Publication Date: 6 July 2000 (06.07.00)

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(22) International Filing Date: 15 December 1999 (15.12.99)

(30) Priority Data:
09/221,412 28 December 1998 (28.12.98) US

(71) Applicant *(for all designated States except US)*: THOMSON CONSUMER ELECTRONICS, INC. [US/US]; 10330 North Meridian Street, Indianapolis, IN 46290–1024 (US).

(72) Inventor; and
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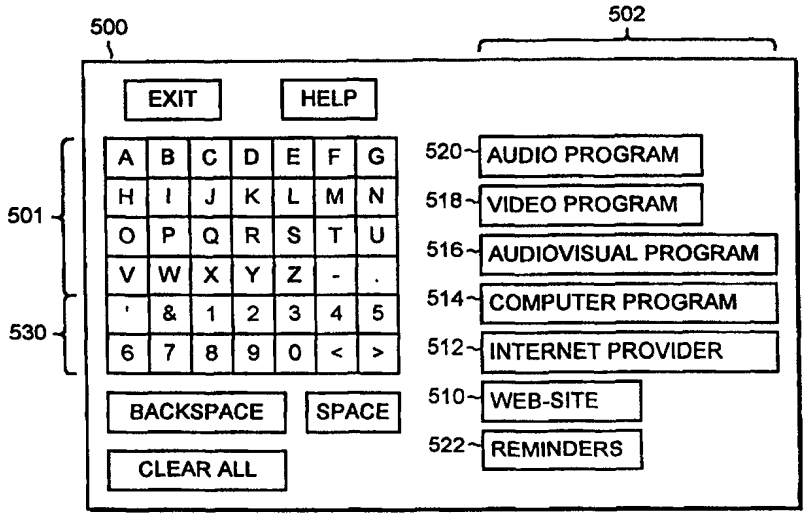


(57) Abstract

An interface and a method for customizing program guide information containing program descriptions is provided. The program guide information is downloaded and stored in a memory, preferably in a generic manner. A menu is generated based on the program guide information. The menu includes program identifiers which can be selected by a user to implement the corresponding programs. The menu then can be customized to include identifier(s) indicative of one or more additional programs or item, including user–specific programs and items which are remotely accessed or locally accessed. After customization, the additional identifiers are selectable by the user to implement the corresponding programs or display the corresponding items. Preferably, the customization is performed locally and interactively using displays generated by an electronic host device or another device connected thereto.

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# SYSTEM AND METHOD FOR CUSTOMIZING PROGRAM GUIDE INFORMATION TO INCLUDE REMINDER ITEM OR LOCAL IDENTIFIER

## FIELD OF INVENTION

This invention generally relates to the field of program guide information processing and more particularly, to a system and method of customizing program guide information.

## BACKGROUND OF INVENTION

Electronic devices such as televisions and personal computers (PC) require a control system that includes a user interface system. Typically, a user interface provides information to a user and simplifies use of the device. One example of a user interface is an Electronic Program Guide (EPG) in a television system.

An EPG is an interactive, on-screen display feature that displays information analogous to TV listings found in local newspapers or other print media. In addition, an EPG also includes information necessary for collating and decoding programs. An EPG provides information about each program within the time frames covered by the EPG which typically ranges from the next hour up to seven days. The information contained in an EPG includes programming characteristics such as channel number, program title, start time, end time, elapsed time, time remaining, rating (if available), topic, theme, and a brief description of the program's content. EPGs are usually arranged in a two-dimensional table or grid format with time information on one axis and channel information on the other axis.

Unlike non-interactive guides that reside on a dedicated channel and merely scroll through the current programming on the other channels for the next 2 to 3 hours, EPGs allow viewers to select any channel at any time during some period into the future, e.g., up to seven days forward. Further EPG features include the ability to highlight individual cells of the grid containing program information. Once highlighted, the viewer can perform functions pertaining to that selected program. For instance, the viewer could instantly switch to that program if it is currently being aired. Viewers could also program one touch video cassette recording (VCR) or the like if the television is properly configured and connected to a recording device. Such EPGs are known in the art and described, for instance, in US Pat. Nos. 5,353,121; 5,479,268; and 5,479,266 issued to Young et al. and assigned to StarSight Telecast, Inc.

In addition, US Pat. No. 5,515,106, issued to Chaney et al., and assigned to the same assignee of the present invention, describes in detail an exemplary embodiment including data packet structure necessary to implement an exemplary program guide system. The exemplary data packet structure is designed so that both the channel information (e.g., channel name, call letters, channel number, type, etc.) and the program description information (e.g., title, rating, star, etc.) relating to a program may be transmitted from a program guide database provider to a receiving apparatus efficiently.

User interfaces such as EPGs are applicable to analog and digital television systems and to other electronic devices such as personal computers. As electronic devices become increasingly complex with a multitude of features, the need for a robust and easy-to-use user interface becomes ever more important. For example,

separate electronic systems having respective interfaces for controlling features of each system are now being combined into a single system requiring a single user interface. One specific example is the so-called PCTV which includes features of both a personal computer and a television. The user interface system for such a device must provide both clear communication of computer and television related information and provide for simple control of both computer and television related features.

One problem with the current EPG system is that the program guide is typically provided in a fixed format (i.e., in a two-dimensional grid format with time information on one axis and channel information on the other axis, as described above). The users typically are not provided with ways to customize the program guide list or to categorize the program guide information.

Another problem with current EPG systems is that the content of the program guide typically is modified only on a generic level for all subscribers to the EPG system. There typically is no way to customize the program guide list to include user-selectable program identifiers corresponding to the user's own programs from a local source (e.g., audio presentations from the user's compact disk collection and/or audiovisual presentations from the user's video tape collection, DVD collection, video disk collection, and/or camcorder), nor is there typically a way to customize the program guide list to include user-selectable program identifiers of any other kind (e.g., shortcuts to web sites, computer programs, and the like) which implement the corresponding program when selected.

## SUMMARY OF THE INVENTION

The present inventor recognizes that an EPG is becoming the preferred way for program navigation in entertainment systems. The present inventor also recognizes that more and more people are spent more and more time in front of such entertainment systems everyday. It is, therefore, desirable to integrate calendaring or scheduling function into an EPG. In other words, it would be desirable, for example, to allow a user to enter a reminder in the EPG, such as "call Mom", "Wife's birthday" or "pay bill" in a time period specified by a user as part of the EPG display. This is especially advantageous since a typical EPG is already being displayed in a time grid format.

A primary object of the present invention is to overcome at least one of the aforementioned problems by providing a user with customizing capabilities so that the user's EPG may be customized to include user-specific programs or items in addition to those which are distributed generically.

To achieve this and other objects of the present invention provides a method of customizing a program guide. The method comprises the steps of : (a) storing program guide information into an electronic host device, the program guide information including program identifiers, each of which designates one of a plurality of programs; (b) generating a menu by displaying at least some of the program identifiers on a display device associated with the electronic host device, the program identifiers being selectable by a user to implement respective ones of the programs; and (c) customizing the menu to include at least one additional identifier which is not from said program guide information.

The present invention also provides an electronically generated interface for displaying and customizing a program guide. The interface comprises program guide information, a menu, and an interface device. The program guide information is stored in an electronic host device and includes program identifiers, each of which designates one of a plurality of programs. The menu includes at least some of the program identifiers on a display device associated with the electronic host device. The program identifiers are selectable by a user to implement respective ones of the programs. The input device is adapted to communicate with the electronic host device to customize the menu so that the menu further includes at least one additional identifier.

The above and other objects and advantages will become more readily apparent when reference is made to the following description taken in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

Fig. 1 shows an example of a television system suitable for processing and customizing program guide information in accordance with the present invention.

Fig. 2 shows an example of a digital video processing apparatus suitable for processing and customizing program guide information in accordance with the present invention.

Fig. 3 is a flow chart of a method of customizing program guide information in accordance with a preferred implementation of the present invention.

Fig. 4 shows an exemplary EPG menu according to a preferred embodiment of the present invention.

Fig. 5 shows a customization display according to a preferred implementation of the present invention.

Fig. 5A shows another customization display.

Fig. 6 shows an exemplary customized menu according to a preferred implementation of the present invention.

Fig. 7 shows an exemplary sub-menu according to a preferred implementation of the present invention.

Fig. 8 shows another exemplary customization display according to a preferred implementation of the present invention.

## DETAILED DESCRIPTION

Fig. 1 shows an example of a television system suitable for processing and customizing program guide information in accordance with the present invention. The television receiver shown in Fig. 1 is capable of processing both analog NTSC television signals and Internet information. The system shown in FIG. 1 has a first input 1100 for receiving television signal RF_IN at RF frequencies and a second input 1102 for receiving baseband television signal VIDEO IN. Signal RF_IN may be supplied from a source such as an antenna or cable system while signal VIDEO IN may be supplied, for example, by a video cassette recorder (VCR). Tuner 1105 and IF processor 1130 operate in a conventional manner for tuning and demodulating a particular television signal that is included in signal RF_IN. IF processor 1130 produces baseband video signal VIDEO representing the video program portion of the tuned television signal. IF processor 1130 also produces a baseband audio signal that is coupled to an audio

processing section (not shown in FIG. 1) for further audio processing. Although FIG. 1 shows input 1102 as a baseband signal, the television receiver could include a second tuner and IF processor similar to units 1105 and 1130 for producing a second baseband video signal from either signal RF_IN or from a second RF signal source.

The system shown in FIG. 1 also includes a main microprocessor (μP) 1110 for controlling components of the television receiver such as tuner 1105, picture-in-picture processing unit 1140, video signal processor 1155, and StarSight® data processing module 1160. As used herein, the term "microprocessor" represents various devices including, but not limited to, microprocessors, microcomputers, microcontrollers and controllers. Microprocessor 1110 controls the system by sending and receiving both commands and data via serial data bus $I^2C$ BUS which utilizes the well-known $I^2C$ serial data bus protocol. More specifically, central processing unit (CPU) 1112 within μP1110 executes control programs contained within memory, such as EEPROM 1127 shown in FIG. 1, in response to commands provided by a user, e.g., via IR remote control 1125 and IR receiver 1122. For example, activation of a "CHANNEL UP" feature on remote control 1125 causes CPU 1112 to send a "change channel" command along with channel data to tuner 1105 via $I^2C$ BUS. As a result, tuner 1105 tunes the next channel in the channel scan list. Other examples of control programs stored in EEPROM 1127 are software for implementing the operations shown in Fig. 3 in accordance with the present invention as to be described below.

Main microprocessor 1110 also controls the operation of a communications interface unit 1113 for providing the capability to

upload and download information to and from the Internet. Communication interface unit 1113 includes, for example, a modem for connecting to an Internet service provider, e.g., via a telephone line or via a cable television line. The communication capability allows the system shown in Figure 1 to provide e-mail capability and Internet related features such as web browsing in addition to receiving television programming.

CPU 1112 controls functions included within μP1110 via bus 1119 within μP1110. In particular, CPU 1112 controls auxiliary data processor 1115 and on-screen display (OSD) processor 1117. Auxiliary data processor 1115 extracts auxiliary data such as StarSight® data from video signal PIPV.

StarSight® data which provides program guide data information in a known format is typically received only on a particular television channel and the television receiver must tune that channel to extract StarSight® data. To prevent StarSight® data extraction from interfering with normal use of the television receiver, CPU 1112 initiates StarSight® data extraction by tuning the particular channel only during a time period when the television receiver is usually not in use (e.g., 2:00 a.m.). At that time, CPU 1112 configures decoder 1115 such that auxiliary data is extracted from horizontal line intervals such as line 16 that are used for StarSight® data. CPU 1112 controls the transfer of extracted StarSight® data from decoder 1115 via $I^2C$ BUS to StarSight® module 1160. A processor internal to the module formats and stores the data in memory within the module. In response to the StarSight® EPG display being activated (e.g., a user activating a particular key on remote control 1125), CPU

1112 transfers formatted StarSight® EPG display data from StarSight® module 1160 via $I^2C$ BUS to OSD processor 1117.

OSD processor 1117 operates in a conventional manner to produce R, G, and B video signals OSD_RGB that, when coupled to a display device, will produce a displayed image representing on-screen display information such as graphics and/or text comprising an EPG. OSD processor 1117 also produces control signal FSW which is intended to control a fast switch for inserting signals OSD_RGB into the system's video output signal at times when an on-screen display is to be displayed. For example, when a user enables an EPG, e.g., by activating a particular switch on remote control 1125, CPU 1112 enables processor 1117. In response, processor 1117 produces signals OSD_RGB representing the program guide data information previously extracted and already stored in memory, as discussed above. Processor 1117 also produces signal FSW indicating when the EPG is to be displayed.

Video signal processor (VSP) 1155 performs conventional video signal processing functions, such as luma and chroma processing. Output signals produced by VSP 1155 are suitable for coupling to a display device, e.g., a kinescope or LCD device (not shown in FIG. 1), for producing a displayed image. VSP 1155 also includes a fast switch for coupling signals produced by OSD processor 1117 to the output video signal path at times when graphics and/or text is to be included in the displayed image. The fast switch is controlled by control signal FSW which is generated by OSD processor 1117 in main microprocessor 1110 at times when text and/or graphics are to be displayed.

The input signal for VSP 1155 is signal PIPV that is output by picture-in-picture (PIP) processor 1140. When a user activates PIP mode, signal PIPV represents a large picture (large pix) into which a small picture (small pix) is inset. When PIP mode is inactive, signal PIPV represents just the large pix, i.e., no small pix signal is included in signal PIPV. PIP processor 1140 provides the described functionality in a conventional manner using features included in unit 1140 such as a video switch, analog-to-digital converter (ADC), RAM, and digital to analog converter (DAC).

For an EPG display, the display data included in the EPG display is produced by OSD processor 1117 and included in the output signal by VSP 1155 in response to fast switch signal FSW. When controller 1110 detects activation of the EPG display, e.g., when a user presses an appropriate key on remote control 1125, controller 1110 causes OSD processor 1117 to produce the EPG display using information such as program guide data from StarSight® module 1160. Controller 1110 causes VSP 1155 to combine the EPG display data from OSD processor 1117 and the video image signal in response to signal FSW to produce a display including EPG. The EPG can occupy all or only a portion of the display area.

When the EPG display is active, controller 1110 executes a control program stored in EEPROM 1127. The control program monitors the location of a position indicator, such as a cursor and/or highlighting, in the EPG display. A user controls the location of the position indicator using direction and selection keys of remote control 1125. Alternatively, the system could include a mouse device. Controller 1110 detects activation of a selection device, such as clicking a mouse button, and evaluates current cursor location

information in conjunction with EPG data being displayed to determine the function desired, e.g., tuning a particular program. Controller 1110 subsequently activates the control action associated with the selected feature.

The processing and displaying of a program guide in accordance with the present invention may be implemented using a combination of software and hardware. For example, referring to Figure 1, display of an EPG may be implemented by software in memory such as EEPROM 1127. Activation of an EPG, e.g., by a user pressing an EPG related button on remote control 1125, causes CPU 1112 to execute the EPG software routine. As part of generating an EPG display, CPU 1112 also accesses EPG data and graphics that may be stored in StarSight module 1160 via the I2C bus. Under control of the EPG software routine stored in EEPROM 1127, CPU 1112 enables OSD processor 1117 which formats the EPG data into a form suitable for producing an OSD representing the EPG data and graphics. The OSD data produced by OSD processor 1117 is coupled to video signal processor (VSP) 1155 via signal lines OSD_RGB. A fast switch in VSP 1155 couples the EPG OSD data to the output of VSP 1155 under control of signal FSW. That is, the software routine being executed by CPU 1112 determines when the EPG data is to be displayed (e.g., what portion of the display) and sets signal FSW to the appropriate state for causing the fast switch to couple the EPG data to the output.

An exemplary embodiment of the features of the system shown in FIG. 1 that have been described thus far comprises an ST9296 microprocessor produced by SGS-Thomson Microelectronics for providing the features associated with µP 1110; an M65616 picture-in-picture processor produced by Mitsubishi for providing the

described basic PIP functionality associated with PIP processor 1140; and an LA7612 video signal processor produced by Sanyo for providing the functions of VSP 1155.

Fig. 2 shows another example of an electronic device capable of processing and customizing program guide information in accordance with the present invention. As described below, the system shown in Figure 2 is an MPEG compatible system for receiving MPEG encoded transport streams representing broadcast programs. However, the system shown in Figure 2 is exemplary only. User interface systems are also applicable to other types of digital signal processing devices including non-MPEG compatible systems, involving other types of encoded datastreams. For example, other devices include digital video disc (DVD) systems and MPEG program streams, and systems combining computer and television functions such as the so-called "PCTV". Further, although the system described below is described as processing broadcast programs, this is exemplary only. The term 'program' is used to represent any form of packetized data such as telephone messages, computer programs, Internet data, audio presentations (e.g., from a remote source or from a local source, such as a compact disk or other audio medium), visual presentations, audiovisual presentations (e.g., from a remote source or a local source, such as a compact disk or other audio medium), or other communications, for example.

In overview, in the video receiver system of Figure 2, a carrier modulated with video data is received by antenna 10 and processed by input processor unit 15. The resultant digital output signal is demodulated by demodulator 20 and decoded by decoder 30. The output from decoder 30 is processed by transport system 25

which is responsive to commands from remote control unit 125. System 25 provides compressed data outputs for storage, further decoding, or communication to other devices.

Video and audio decoders 85 and 80 respectively, decode the compressed data from system 25 to provide outputs for display. Data port 75 provides an interface for communication of the compressed data from system 25 to other devices such as a computer or High Definition Television (HDTV) receiver, for example. Storage device 90 stores the compressed data from system 25 on storage medium 105. Device 90, in a playback mode also supports retrieval of the compressed data from storage medium 105 for processing by system 25 for decoding, communication to other devices or storage on a different storage medium (not shown to simplify drawing).

Considering Figure 2 in detail, a carrier modulated with video data received by antenna 10, is converted to digital form and processed by input processor 15. Processor 15 includes radio frequency (RF) tuner and intermediate frequency (IF) mixer and amplification stages for down-converting the input video signal to a lower frequency band suitable for further processing. The resultant digital output signal is demodulated by demodulator 20 and decoded by decoder 30. The output from decoder 30 is further processed by transport system 25.

Multiplexer (mux) 37 of service detector 33 is provided, via selector 35, with either the output from decoder 30, or the decoder 30 output further processed by a descrambling unit 40. Descrambling unit 40 may be, for example, a removable unit such as a smart card in accordance with ISO 7816 and NRSS (National Renewable Security Standards) Committee standards (the NRSS

removable conditional access system is defined in EIA Draft Document IS-679, Project PN-3639). Selector 35 detects the presence of an insertable, compatible, descrambling card and provides the output of unit 40 to mux 37 only if the card is currently inserted in the video receiver unit. Otherwise selector 35 provides the output from decoder 30 to mux 37. The presence of the insertable card permits unit 40 to descramble additional premium program channels, for example, and provide additional program services to a viewer. It should be noted that in the preferred embodiment NRSS unit 40 and smart card unit 130 (smart card unit 130 is discussed later) share the same system 25 interface such that only either an NRSS card or a smart card may be inserted at any one time. However, the interfaces may also be separate to allow parallel operation.

The data provided to mux 37 from selector 35 is in the form of an MPEG compliant packetized transport datastream as defined in MPEG systems standard section 2.4 and includes program guide information and the data content of one or more program channels. The individual packets that comprise particular program channels are identified by Packet Identifiers (PIDs). For example, a program content such as audio and video information for a particular channel may be identified by one PID, while packet containing program guide information may be identified by another PID. The transport stream contains Program Specific Information (PSI) for use in identifying the PIDs and assembling individual data packets to recover the content of all the program channels that comprise the packetized datastream. Transport system 25, under the control of the system controller 115, acquires and collates program guide information from the input transport stream, storage device 90 or an

Internet service provider via the communication interface unit 116. The individual packets that comprise either particular program channel content or Program Guide information, are identified by their Packet Identifiers (PIDs) contained within header information. As discussed above, the program description may comprise different program descriptive fields such as title, star, rating, etc., relating to a program.

The user interface incorporated in the video receiver shown in Figure 2 enables a user to activate various features by selecting a desired feature from an on-screen display (OSD) menu. The OSD menu may include an electronic program guide (EPG) as described above and other features discussed below. Data representing information displayed in the OSD menu is generated by system controller 115 in response to stored program guide information, stored graphics information, and/or program guide and graphics information received via the input signal (e.g., StarSight data) as described above and in accordance with an exemplary control program to be shown in Fig. 3 and to be described below. The software control program may be stored, for example, in embedded memory (not shown) of system controller 115.

Using remote control unit 125 (or other selection means such as a mouse) a user can select from the OSD menu items such as a program to be viewed, a program to be stored, the type of storage media and manner of storage. System controller 115 uses the selection information, provided via remote unit interface 120, to configure system 25 to select the programs for storage and display and to generate PSI suitable for the selected storage device and media. Controller 115 configures system 25 elements 45, 47, 50, 55,

65 and 95 by setting control register values within these elements via a data bus and by selecting signal paths via muxes 37 and 110 with control signal C.

In response to control signal C, mux 37 selects either, the transport stream from unit 35, or in a playback mode, a datastream retrieved from storage device 90 via store interface 95. In normal, non-playback operation, the data packets comprising the program that the user selected to view are identified by their PIDs by selection unit 45. If an encryption indicator in the header data of the selected program packets indicates the packets are encrypted, unit 45 provides the packets to decryption unit 50. Otherwise unit 45 provides non-encrypted packets to transport decoder 55. Similarly, the data packets comprising the programs that the user selected for storage are identified by their PIDs by selection unit 47. Unit 47 provides encrypted packets to decryption unit 50 or non-encrypted packets to mux 110 based on the packet header encryption indicator information.

The functions of decryptors 40 and 50 may be implemented in a single removable smart card which is compatible with the NRSS standard. This approach places all security related functions in one removable unit that easily can be replaced if a service provider decides to change encryption technique or to permit easily changing the security system, e.g., to descramble a different service.

Units 45 and 47 employ PID detection filters that match the PIDs of incoming packets provided by mux 37 with PID values pre-loaded in control registers within units 45 and 47 by controller 115. The pre-loaded PIDs are used in units 47 and 45 to identify the

data packets that are to be stored and the data packets that are to be decoded for use in providing a video image. The pre-loaded PIDs are stored in look-up tables in units 45 and 47. The PID look-up tables are memory mapped to encryption key tables in units 45 and 47 that associate encryption keys with each pre-loaded PID. The memory mapped PID and encryption key look-up tables permit units 45 and 47 to match encrypted packets containing a pre-loaded PID with associated encryption keys that permit their decryption. Non-encrypted packets do not have associated encryption keys. Units 45 and 47 provide both identified packets and their associated encryption keys to decryptor 50. The PID look-up table in unit 45 is also memory mapped to a destination table that matches packets containing pre-loaded PIDs with corresponding destination buffer locations in packet buffer 60. The encryption keys and destination buffer location addresses associated with the programs selected by a user for viewing or storage are pre-loaded into units 45 and 47 along with the assigned PIDs by controller 115. The encryption keys are generated by ISO 7816-3 compliant smart card system 130 from encryption codes extracted from the input datastream. The generation of the encryption keys is subject to customer entitlement determined from coded information in the input datastream and/or pre-stored on the insertable smart card itself (International Standards Organization document ISO 7816-3 of 1989 defines the interface and signal structures for a smart card system).

The packets provided by units 45 and 47 to unit 50 are encrypted using encryption techniques such as the Data Encryption Standard (DES) defined in Federal Information Standards (FIPS) Publications 46, 74 and 81 provided by the National Technical

Information Service, Department of Commerce. Unit 50 decrypts the encrypted packets using corresponding encryption keys provided by units 45 and 47 by applying decryption techniques appropriate for the selected encryption algorithm. The decrypted packets from unit 50 and the non-encrypted packets from unit 45 that comprise the program for display are provided to decoder 55. The decrypted packets from unit 50 and the non-encrypted packets from unit 47 that comprise the program for storage are provided to mux 110.

Unit 60 contains four packet buffers accessible by controller 115. One of the buffers is assigned to hold data destined for use by controller 115 and the other three buffers are assigned to hold packets that are destined for use by application devices 75, 80 and 85. Access to the packets stored in the four buffers within unit 60 by both controller 115 and by application interface 70 is controlled by buffer control unit 65. Unit 45 provides a destination flag to unit 65 for each packet identified by unit 45 for decoding. The flags indicate the individual unit 60 destination locations for the identified packets and are stored by control unit 65 in an internal memory table. Control unit 65 determines a series of read and write pointers associated with packets stored in buffer 60 based on the First-In-First-Out (FIFO) principle. The write pointers in conjunction with the destination flags permit sequential storage of an identified packet from units 45 or 50 in the next empty location within the appropriate destination buffer in unit 60. The read pointers permit sequential reading of packets from the appropriate unit 60 destination buffers by controller 115 and application interface 70.

The non-encrypted and decrypted packets provided by units 45 and 50 to decoder 55 contain a transport header as defined

by section 2.4.3.2 of the MPEG systems standard. Decoder 55 determines from the transport header whether the non-encrypted and decrypted packets contain an adaptation field (per the MPEG systems standard). The adaptation field contains timing information including, for example, Program Clock References (PCRs) that permit synchronization and decoding of content packets. Upon detection of a timing information packet, that is a packet containing an adaptation field, decoder 55 signals controller 115, via an interrupt mechanism by setting a system interrupt, that the packet has been received. In addition, decoder 55 changes the timing packet destination flag in unit 65 and provides the packet to unit 60. By changing the unit 65 destination flag, unit 65 diverts the timing information packet provided by decoder 55 to the unit 60 buffer location assigned to hold data for use by controller 115, instead of an application buffer location.

Upon receiving the system interrupt set by decoder 55, controller 115 reads the timing information and PCR value and stores it in internal memory. PCR values of successive timing information packets are used by controller 115 to adjust the system 25 master clock (27 MHz). The difference between PCR based and master clock based estimates of the time interval between the receipt of successive timing packets, generated by controller 115, is used to adjust the system 25 master clock. Controller 115 achieves this by applying the derived time estimate difference to adjust the input control voltage of a voltage controlled oscillator used to generate the master clock. Controller 115 resets the system interrupt after storing the timing information in internal memory.

Packets received by decoder 55 from units 45 and 50 that contain program content including audio, video, caption, and other information, are directed by unit 65 from decoder 55 to the designated application device buffers in packet buffer 60. Application control unit 70 sequentially retrieves the audio, video, caption and other data from the designated buffers in buffer 60 and provides the data to corresponding application devices 75, 80 and 85. The application devices comprise audio and video decoders 80 and 85 and high speed data port 75. For example, packet data corresponding to a composite program guide generated by the controller 115 as described above, may be transported to the video decoder 85 for formatting into video signal suitable for display on a monitor (not shown) connected to the video decoder 85. Also, for example, data port 75 may be used to provide high speed data such as computer programs, for example, to a computer. Alternatively, port 75 may be used to output data to an HDTV decoder to display images corresponding to a selected program or a program guide, for example.

Packets that contain PSI information are recognized by unit 45 as destined for the controller 115 buffer in unit 60. The PSI packets are directed to this buffer by unit 65 via units 45, 50 and 55 in a similar manner to that described for packets containing program content. Controller 115 reads the PSI from unit 60 and stores it in internal memory.

Controller 115 also generates condensed PSI (CPSI) from the stored PSI and incorporates the CPSI in a packetized datastream suitable for storage on a selectable storage medium. The packet identification and direction is governed by controller 115 in conjunction with the unit 45 and unit 47 PID, destination and

encryption key look-up tables and control unit 65 functions in the manner previously described.

In addition, controller 115 is coupled to a communication interface unit 116 that operates in a manner similar to interface unit 1113 in Figure 1. That is, unit 116 provides the capability to upload and download information to and from the Internet. Communication interface unit 116 includes, for example, a modem for connecting to an Internet service provider, e.g., via a telephone line or via a cable television line. The communication capability allows the system shown in Figure 2 to provide e-mail capability and Internet related features such as web browsing in addition to receiving television programming.

Fig. 3 is a high-level flow chart of an exemplary control program which, according to the present invention, may be executed by controller 1110 of Fig. 1, controller 115 of Fig. 2, or any other suitably programmed control arrangement of an electronic host device. The term "electronic host device" as used herein is not limited to television receivers or personal computers, but rather encompasses hybrids thereof (e.g., PCTVs), cable television converter boxes, suitably equipped audiovisual program recorders (e.g., video tape recorders), satellite television and/or data signal converters, program guide receiver units, and the like, regardless of whether incorporated into a television receiver or personal computer or connected externally thereto. It will be appreciated that the process embodied in the exemplary control program may be implemented in hardware, software, or a combination thereof.

The exemplary control program as shown in Fig. 3, when executed, facilitates display and customization of a program guide. A

person skilled in the art would readily recognize from the flow chart and the following description that the control program when executed by any one of the systems described in Figs. 1 and 2 or by any other suitably programmed electronic host device will provide substantially the same features and advantages in accordance with the present invention. Therefore, to avoid redundancy, the control program will be described below only with respect to the exemplary hardware implementation shown in Fig. 2.

According to the exemplary program, controller 115 of Fig. 2 initially executes the step S1 of storing program guide information received from a program guide database provider as described above in connection with Fig. 2.

The program guide information received preferably is generic to the extent that other subscribers receive the same or similar program guide information. This generic program guide information is downloaded using one of a plurality of known distribution protocols, as described above.

Included with the program guide information are program identifiers. Each of the program identifiers designates one of a plurality of programs which can be implemented (e.g., displayed, audibly broadcast, or executed) by the electronic host device itself or which can be implemented by a display device, audio equipment or a computer associated with the electronic host device.

As shown in Figure 3, application interface 70 under the control of the controller 115, generates a menu (Step S2) by displaying at least some of the program identifiers on a display device (not shown) associated with the electronic host device. Part of the function of the application interface 70 is to process OSD information

corresponding to an EPG that is generated by the controller 115. Preferably, this EPG menu is generated in response to the EPG display being activated (e.g., a user activating a particular key on remote control 125). In response to such activation, the controller 115 transfers EPG display data to application interface 70. Application interface 70 then outputs the corresponding display information to the video decoder for displaying on a display device (not shown).

An exemplary EPG menu 400 is shown in Figure 4. The menu 400 includes a "grid guide" 400A which shows a program schedule in a time-and-channel format, similar to a TV schedule listed in a newspaper. One dimension (e.g., the horizontal dimension) of the "grid guide" 400A shows the time information 401, while the other dimension (e.g., the vertical dimension) of the "grid guide" 400A shows channel information. When an abbreviated element 430 of the "grid guide" is highlighted or a cursor is located thereon, as will be described hereinafter, the truncated parts of the abbreviated element 430 appear in a "highlighted text" field 440 of the menu 400.

In the menu 400, each of the program identifiers (e.g., channel numbers 410-416, channel station names 420-426, web-site identifier 470, Internet identifier 450, e-mail identifier 460, or the like) is selectable by a user to implement respective ones of the programs. In particular, the controller 115 monitors the location of a position indicator, such as a cursor and/or highlighting, on the EPG menu display. A user controls the location of the position indicator using direction and selection keys of remote control 125 as described above. Alternatively, the system could include a mouse device or an appropriate pointer device.

Controller 115 detects activation of a selection device, such as clicking a key on remote control device 125 or clicking on a mouse button, and evaluates current cursor/highlighting location information in conjunction with EPG menu data being displayed to determine the function desired (e.g., implementing a particular program). If such activation of the selection device is performed while the cursor and/or highlighting is located on one of the program identifiers, the controller 115 determines that the corresponding program is to be implemented (i.e., displayed, audibly broadcast, and/or executed). Controller 115 subsequently activates the control and/or display action associated with the selected program.

If, for example, the selected program identifier represents a web-site, the controller 115 implements a web-browsing program and accesses the corresponding web-site. When the selected program identifier is associated with an audio program, video program, or audiovisual program, the controller 1110 responds by tuning the electronic host device or an associated receiver to the appropriate channel and by displaying and/or audibly broadcasting that program. Highlighting of such programs and subsequent selection of other function icons on the menu 400 can implement automatic tuning at a later time to the selected program or automatic recording thereof by the electronic host device or by another device connected to the electronic host device.

Selection of the "Internet" identifier 450 causes the controller 1110 to implement a web-browsing program through an Internet service provider, while selection of the "e-mail" identifier 460 causes the controller 450 to implement an e-mail transmission

and/or reception program through the same or a different Internet service provider.

While the system and method provided by steps S1 and S2 in Figure 3 and by the menu 400 in Figure 4 achieve a generally effective and convenient EPG arrangement, the resulting arrangement is limited to the generic program information provided by the EPG distributor. It provides no way of customizing the menu to include program identifiers associated with any of the subscriber's own local sources of programming.

The subscriber, for example, may have a collection of audiovisual or visual information from a camcorder, a CD-based collection of audio presentations (e.g., music), a collection of video programs on optical disk, magnetic tape, and the like, and/or a collection of computer programs, all of which can be implemented locally by the electronic host device or devices connected thereto. The subscriber also may have access to additional programming through remote sources, such as alternative Internet service providers, satellite service providers, and the like. It would be convenient to incorporate program identifiers associated with such user-specific sources into the EPG menu, so that the user can simply select such program identifiers from the menu to implement the corresponding program in a manner similar to the selection and implementation of the programs which are included in the generic program guide information.

Also, as discussed above, it is desirable to be able to integrate the ability to have personalized calendaring or scheduling function as a part of the EPG, since a large amount of time is now spent looking at an EPG.

As shown in Figure 3, the exemplary method of the present invention therefore includes the additional step S3 of customizing the menu to include at least one additional identifier. The identifier may identifies a program which is selectable by a user (e.g., an audio presentation from a collection of such presentations on one or more forms of locally maintained audio media), or a reminder item (e.g., items of things to do). The customization preferably is performed locally by the user of the electronic host device. The locally performed customization can be performed using a keyboard or other input device dedicated to such customization, or alternatively, can be performed, as will be described hereinafter, using hardware which is also used in performing functions of the electronic host device other than customization.

Preferably, the step of customizing is performed interactively. That is, the user communicates to the electronic host device (e.g., by pressing a "customization" button on remote control 125 or on the electronic host device) a desire to customize the menu, and the electronic host device then responds by generating a customization display which enables and/or prompts the user to enter program guide information pertaining to the additional user-specific program(s) which the user wishes to incorporate into the menu.

An exemplary customization display 500 is shown in Figure 5. The exemplary customization display 500 preferably includes a display 501 of every letter in the alphabet (i.e., a virtual keyboard), each of which can be selected using the remote control unit 125, a mouse or the like.

Also included is a field 502 of program type indicators 510-522. The program type indicators 510-522 are user-selectable

to inform the electronic host device of the type of program or item which is being incorporated into the menu 400. When one of the program type indicators 510-522 is selected from the customization display, the controller 115 responds by prompting the user to enter program or item specific information pertaining to the additional program or item which is to be incorporated into the menu.

The program or item specific information can include, for example, the characteristic information described above, namely, program title, program theme, program category, program keywords, program description, program type, program length, program starting time, program ending time, repeat frequency, or combinations thereof. The program description itself may include, for example, stars, director, parental rating, a short summary of the content of a program, and/or the like. The program-specific information also may include an input/output port designation. The input/output port designation indicates to the controller 115 where the source of the additional program will be connected to the electronic host device. Examples of such input/output ports are computer local ports, computer communication ports, jacks for audio, video, and/or audiovisual devices, and the like.

In addition, program specific-information for program type indicator of "REMINDERS" 522 comprises information about a reminder item to be entered by a user, such as, for example, "call Mom"; "do homework"; or "daughter's birthday", etc., as shown in Fig. 5A. In addition, the user may be prompted to enter a time slot associated with the entered item, to be described below.

The user enters the program or item specific information by successively selecting the letters from the alphabetic display.

Alternatively, the program or item specific information can be entered by selecting one of a plurality of predetermined choices which are presented to the user by the controller 115 as the controller 115 prompts the user to enter each item of program or item specific information.

One example of the predetermined choices involves selection of the input/output ports. Since the electronic host device typically is configured with only a certain number of such ports and with only certain types of ports, the controller 115 can be easily programmed to display indicators associated with each of such ports, and preferably of only those ports which are available for selection by the user during entry of the program-specific information. This way, the user need not memorize all of the types of ports and the number of available ports. Preferably, the controller 1110 determines which choices are available based on which ports are compatible with the type of program being incorporated into the menu 400, and displays as the user-selectable choices only those ports which are compatible.

In another aspect of the present invention, when a user selects "REMINDER" program type indicator 522, an exemplary customization display 550 for entering item specific information for an electronic scheduling function will appear as shown in Fig. 5A. The user may then enter a to-do item in field 551 using, for example, the virtual keyboards 501 and 530. In addition, the user may specify a time period for which this reminder item should appear on the EPG by entering the time and date information in field 552. The user can provide or edit information for additional reminder items by selecting the previous or next reminder keys 553 and 554.

Once the program or item specific information has been entered, the controller 1110 updates the program guide information to include the program or item specific information, including an additional identifier indicative of the added program or reminder item. Preferably, this update occurs only after the user has entered an appropriate "save" command (e.g., via the remote control 125 and/or selection of an appropriate "save" item on the menu 400) to verify that the program or item specific information is correct and that the additional identifier is to appear in the menu 400.

The next time the menu 400 is displayed, the controller 115 incorporates the additional identifier into the menu 400 at an appropriate location. The location of the additional identifier in the menu 400 preferably is determined according to the characteristic information which was entered by the user for that particular program. In addition, any alphabetizing of titles (e.g., by pressing "A-Z" indicator 480), sorting by theme, by category, or by type of programming, sorting by title (as opposed to channel), keyword searches, simplified recording commands (e.g., one-touch recording), and/or other search and analysis techniques, which the controller 115 was able to perform on the generic program guide information also can be performed by the controller 115 on the combination of the generic program guide information and the program guide information which was added to the menu 400 through customization. As an example, Fig. 6 shows that the reminder item "CALL MOM" which has been entered as described above, now appears on the bottom of a customized EPG menu 600, at the entered time slot of 5:30 p.m. This information appears on the "Reminder" cell 428, as part of the EPG 400A.

In this regard, the controller 115 preferably treats the user specified program guide information in substantially the same way as it treats the generic program guide information. Such treatment extends into the functions carried out by selection of the various icons which appear across the bottom of the menus in Figures 4, 6, 7 and 7A.

For example, with regard to keyword searching, the controller 115 preferably is programmed to respond to a keyword search command from a user. Such a command can be provided by selecting a corresponding one of the icons along the bottom of the menus in Figures 4, 6, 7 or 7A. The controller 115 preferably is programmed to respond to such a command by prompting the user to enter a string of letters representing the keyword(s). The keyword(s) can be entered using the remote control 125, a suitable display screen with or without a virtual keyboard, and/or the like. The keyword(s) typically will be a word(s) or term(s) which the user believes to be present in the characteristic information of a desired one of the programs or added programs represented by the customized program guide information. The controller 115 responds to entry of the keywords by searching the characteristic information for occurrences of (or matches with) the keyword(s). The controller 115 then modifies the menu (e.g., menu 400) to display those of the program or item identifiers and the additional program or item identifier(s) which have matching terms in the characteristic information associated therewith.

Another example of a customization sequence involves customizing the menu 400 to include an identifier indicative of a compact disk collection. In particular, the user commences the

customization sequence by appropriately communicating to the electronic host device (e.g., via the remote control 125) the user's intention to effect customization of the menu 400.

The controller 115 responds by generating the customization menu 500 shown in Figure 5. Once the customization menu 500 has been displayed, the user selects the "audio" program type indicator 520, thereby communicating to the controller 115 that an audio program is to be added to the menu 400. The controller 115, in response, generates one or more display fields (either simultaneously or sequentially) prompting the user to enter the program-specific information. The program-specific information can include, for example, information indicative of which audio jacks will be connected to the CD player, titles of some or all of the CDs in the collection, names of artist(s) on each of the CDs, titles of songs or tracks on the CDs, categories of content (e.g., music, drama, and the like), sub-categories of content (easy listening music, rock-and-roll music, classical music, and the like), keywords associated with each CD and its individual tracks, or combinations thereof.

Alternatively, the designation of audio jacks can be performed, as indicated above, and the controller 115 can be programmed to respond to such a designation by reading some or all of the program-specific information other than the audio jack designation from the CDs in the CD player or from the CD player itself. Regardless of the particular technique which is used to enter the program-specific information, the controller 115 responds by customizing the menu 400 accordingly.

Customized menu 600, in addition to including the program identifiers associated with the generic programming, also

includes a program identifier 601 indicative of the compact disk collection. The added program identifier 601 may include a simple description of the additional program (as shown), or alternatively, a graphical representation of the additional program (e.g., an icon that looks like a compact disk). A combination of a description and a graphical representation can be provided as yet another alternative.

Depending on the program-specific information or desired operation of the electronic host device, the controller 600 can be programmed to respond to selection of the added program identifier 601 by either starting to play a particular one of the tracks on a particular one of the CDs or by generating a sub-menu of some or all of the program-specific information associated with the CD collections.

The sub-menu can be provided as part of the customized menu 600, or alternatively, in place thereof. Several layers of sub-menus also can be provided, for example, based on a hierarchy of the program-specific information. At a first level in the hierarchy of sub-menus, the display can present choices among categories of programs, such as musical CDs versus dramatic CDs. Selection of one of the categories by the user then causes the controller 115 to display, for example, titles of the programs within the selected category. It will be appreciated from the present application that numerous combinations of sub-menus and hierarchical configurations can be implemented in accordance with the present invention.

In another aspect of the invention, Fig. 6 also shows that there is now an identifier "REMINDER" being displayed in cell 428 as described above. Cell 429 shows that there is a reminder item 429 that has already been entered by a user previously. To find out more

information about this reminder item or to perform further editing on this item, the user may simply select cell 429 using the remote entry device 125. Once this cell is selected, customization display 550, for example, will be shown. This allows the user to see the full text of the reminder item which is not shown in the grid guide of 600 in Fig. 6, due to space limitation of cell 429. The user may also edit the reminder item, as described above in connection with Fig. 5A.

Figure 7 shows an exemplary sub-menu 700 which can be provided while maintaining certain parts (e.g., the top three lines of the "grid guide" 400A) of the customized menu 600. The exemplary sub-menu 700 includes program identifiers 710, 720, and 730 indicative of respective musical works. Following each program identifier 710, 720, and 730 is the title of the musical work, the artist, and a description of the musical work.

The controller 115 is programmed by virtue of the customization process and appropriate software and/or hardware, to commence in response to a user's selection of one of the program identifiers 710, 720 or 730, audible broadcasting of the selected musical work (e.g., "The Wall" by Pink Floyd) through an appropriate speaker incorporated in or connected to the electronic host device.

The controller 115 also may be programmed to permit editing or deletion of any of the program guide information being displayed, or alternatively, editing or deletion of only the added program guide information displayed. In this regard, the customization display 500 or sub-menus associated therewith can be provided with user-selectable "edit" or "delete" items (not shown) which, when selected, implement an editing or deletion process. Preferably, the controller 115 is programmed so that, during the

editing or deletion process, the user selects the item(s) of program guide information to be edited or deleted using the remote control 125 or otherwise, and the controller 115 responds by displaying the selected program guide information in a user-editable or user-deletable manner on the customization display 500. After editing or deletion, the editing or deletion process can be finalized by selection of a "save" item (not shown) on the customization display 500.

In addition, Fig. 8 shows another preferred embodiment of the present invention for customizing an EPG. Fig. 8 shows a preferred embodiment of an EPG in which the text in a selected cell of the EPG may be edited. For example, a user may select cell 750 via user entry device 125. Once the cell 750 is highlighted, the user may further select an edit text mode via, for example, a key on the user entry device 125. Once this mode is selected, a user is then able to enter a desired text such as "WIFE'S BIRTHDAY", using any one of the possible user entry methods as described above. Similarly, a user may change the existing text of a select cell 760 and change the name of the song "THE GOLDEN ERA" to, for example, "THE ERA." This capability provides a user an easy and fast way to customize an EPG directly.

According to the present invention, the programs which are represented by the program guide information can include, among other things, video presentations, audio presentations, audiovisual presentations, computer programs, web browsing programs, reminder items, and/or contents of a web site.

It is to be understood that the embodiments and variations shown and described herein are for illustrations only and

that various modifications may be implemented by those skilled in the art without departing from the scope and spirit of the invention.

CLAIMS

1. A method of customizing a program guide, said method comprising the steps of:

storing program guide information into an electronic host device, said program guide information including program identifiers, each of which designates one of a plurality of programs;

generating a menu by displaying at least some of said program identifiers on a display device associated with said electronic host device, said program identifiers being selectable by a user to implement respective ones of said programs; and

customizing said menu to include at least one additional identifier which is selectable by a user to implement a function associated with said identifier.

2. The method of claim 1, wherein said step of storing program guide information is performed generically, whereas said step of customizing is performed interactively in response to user input.

3. The method of claim 1, wherein said plurality of programs include a combination selected from the group consisting of: video presentations, audio presentations, audiovisual presentations, computer programs, web browsing programs, and contents of a web site.

4. The method of claim 1, wherein said additional identifier identifies an additional program not originally identified in said program guide information.

5. The method of claim 1 wherein said additional identifier identifies a reminder item specified by said user.

6. The method of claim 4 wherein said function comprises implementing said additional program.

7. The method of claim 5 wherein said function comprises displaying said reminder item.

8. The method of claim 1, wherein said step of storing program guide information is performed using a distribution protocol, whereas said step of customizing is performed locally by said user.

9. The method of claim 8, wherein said distribution protocol includes transmission of the program guide information to the electronic host device via a modem associated with the electronic host device.

10. The method of claim 4, wherein said program guide information further includes characteristic information for each of said plurality of programs, and wherein said step of customizing said menu to include at least one additional identifier includes storing characteristic information at said electronic host device for each of said at least one additional program.

11. The method of claim 10, wherein said characteristic information includes information selected from the group consisting of: program title, program theme, program category, program

keywords, program description, program type, program length, program starting time, program ending time, repeat frequency, and combinations thereof.

12. The method of claim 11, further comprising the step of sorting said program identifiers and said at least one additional identifier in said menu based on said characteristic information.

13. The method of claim 12, further comprising the steps of:

entering at least one term believed to be in the characteristic information of a desired program;

searching through said characteristic information to find matches with said at least one term; and

modifying said menu to display those of said identifiers and said at least one additional program identifier which have matching terms in the characteristic information associated therewith.

14. The method of claim 4, wherein said at least one additional program includes at least one audio presentation from at least one local audio medium.

15. The method of claim 4, wherein said at least one additional program includes at least one audiovisual presentation from at least one local audiovisual medium.

16. The method of claim 4, wherein said at least one additional program includes at least one audiovisual presentation from a camcorder.

17. The method of claim 4, wherein said at least one additional program includes at least one audio presentation from at least one local audio medium, at least one audiovisual presentation from at least one local audiovisual medium, and at least one audiovisual presentation from a camcorder.

18. An electronically generated interface for displaying and customizing a program guide, said interface comprising:

program guide information stored in an electronic host device, said program guide information including program identifiers, each of which designates one of a plurality of programs;

a menu of at least some of said program identifiers on a display device associated with said electronic host device, said program identifiers being selectable by a user to implement respective ones of said programs; and

an input device adapted to communicate with said electronic host device to customize said menu so that said menu further includes at least one additional identifier which is selectable by a user to implement a function associated with said additional identifier.

19. The interface of claim 18, wherein said additional identifier identifies an additional program not originally identified in said program guide information.

20. The interface of claim 18 wherein said additional identifier identifies a reminder item specified by said user.

21. The method of claim 19 wherein said function comprises implementing said additional program.

22. The method of claim 20 wherein said function comprises displaying said reminder item.

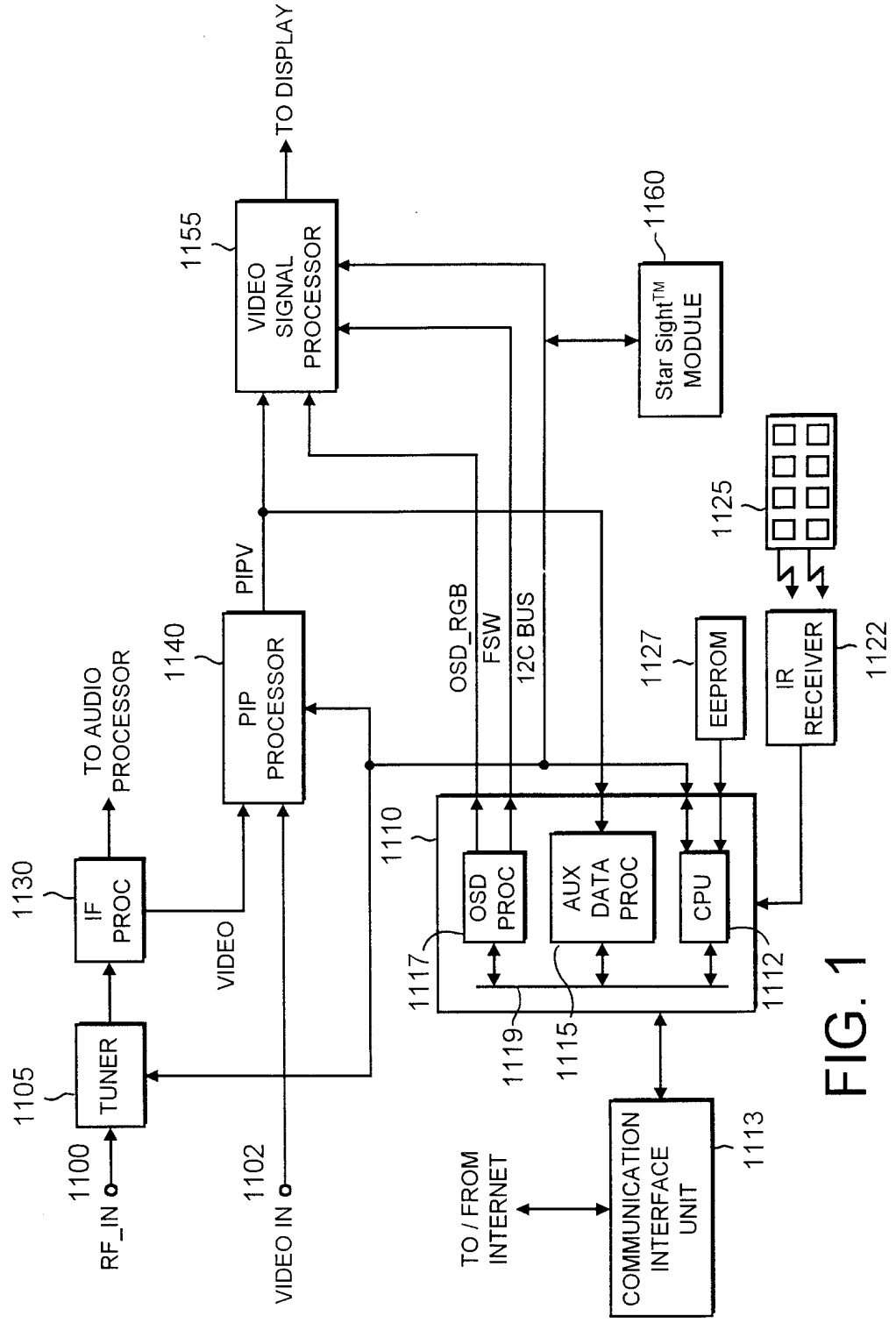
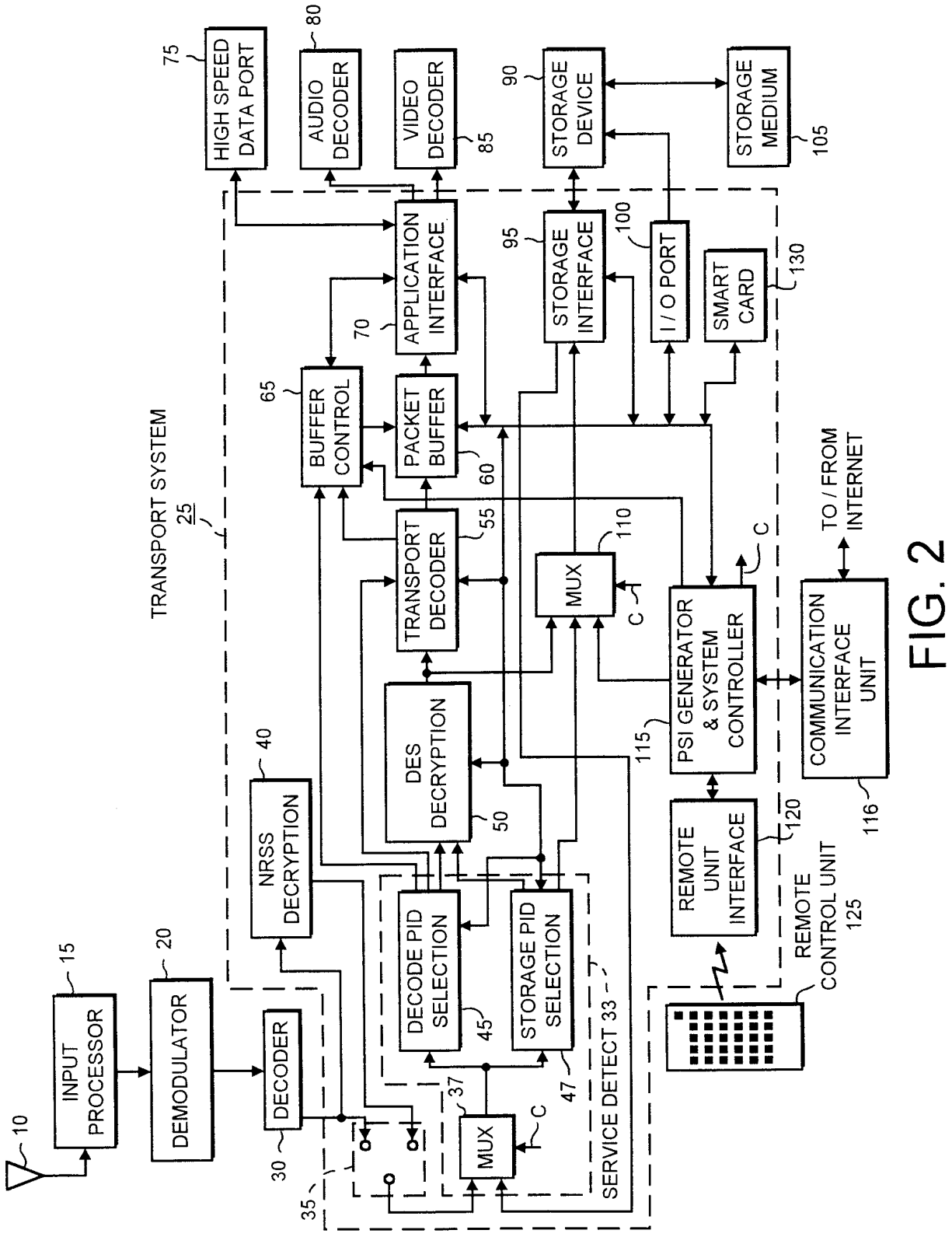

RF_IN
1100
TUNER
1105
IF PROC
1130
TO AUDIO PROCESSOR
VIDEO
VIDEO IN
1102
PIP PROCESSOR
1140
PIPV
VIDEO SIGNAL PROCESSOR
1155
TO DISPLAY
OSD_RGB
FSW
12C BUS
1110
OSD PROC
AUX DATA PROC
CPU
1117
1119
1115
1112
Star Sight™ MODULE
1160
EEPROM
1127
IR RECEIVER
1122
1125
COMMUNICATION INTERFACE UNIT
1113
TO / FROM INTERNET

FIG. 1


10
INPUT PROCESSOR
15
DEMODULATOR
20
DECODER
30
35
TRANSPORT SYSTEM
25
HIGH SPEED DATA PORT
75
AUDIO DECODER
80
VIDEO DECODER
85
STORAGE DEVICE
90
STORAGE MEDIUM
105
APPLICATION INTERFACE
70
STORAGE INTERFACE
95
I / O PORT
100
SMART CARD
130
BUFFER CONTROL
65
PACKET BUFFER
60
TRANSPORT DECODER
55
MUX
110
C
TO / FROM INTERNET
COMMUNICATION INTERFACE UNIT
116
PSI GENERATOR & SYSTEM CONTROLLER
115
REMOTE UNIT INTERFACE
120
REMOTE CONTROL UNIT
125
NRSS DECRYPTION
40
DES DECRYPTION
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DECODE PID SELECTION
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47
MUX
37
C
SERVICE DETECT 33

FIG. 2

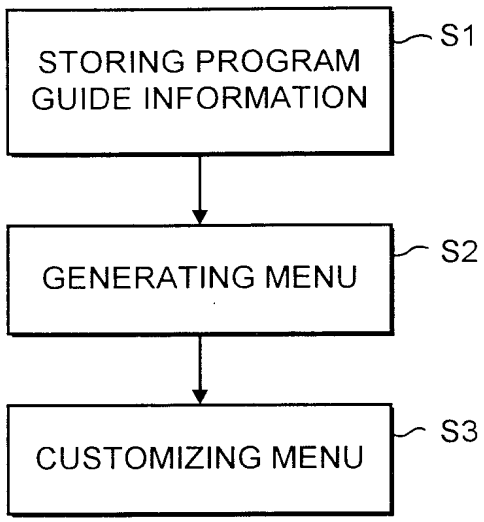

STORING PROGRAM GUIDE INFORMATION
S1
GENERATING MENU
S2
CUSTOMIZING MENU
S3

FIG. 3

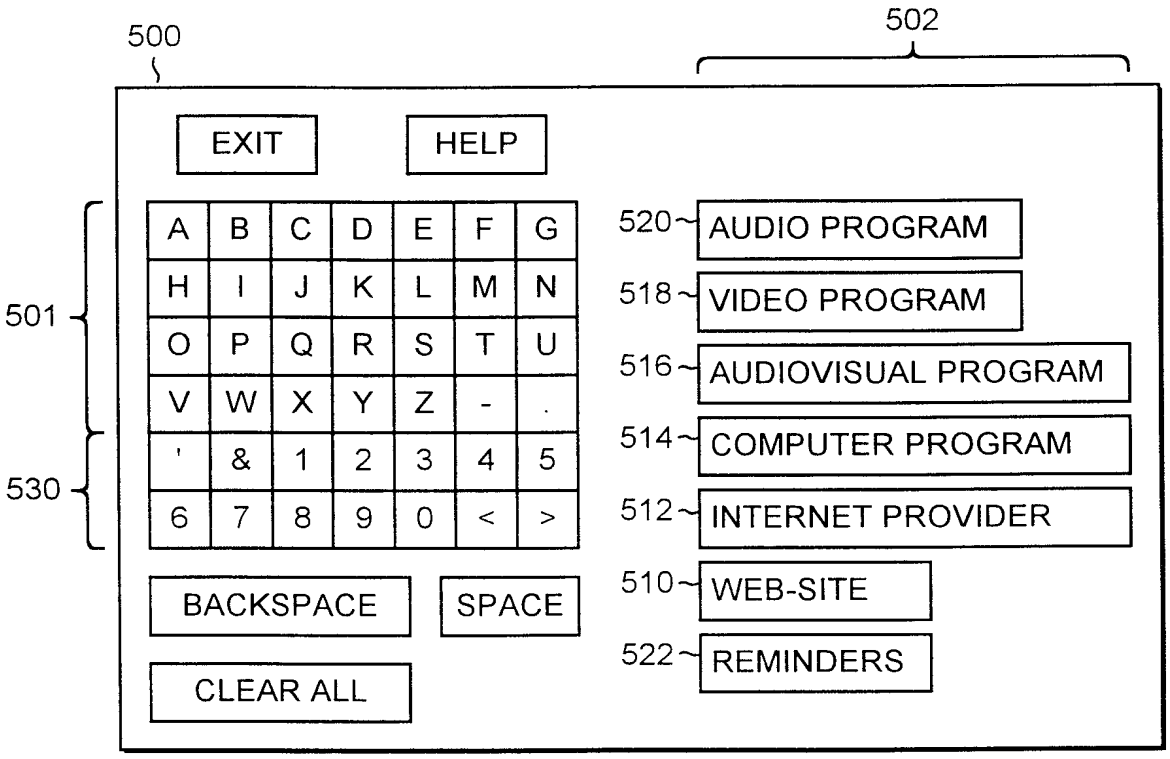
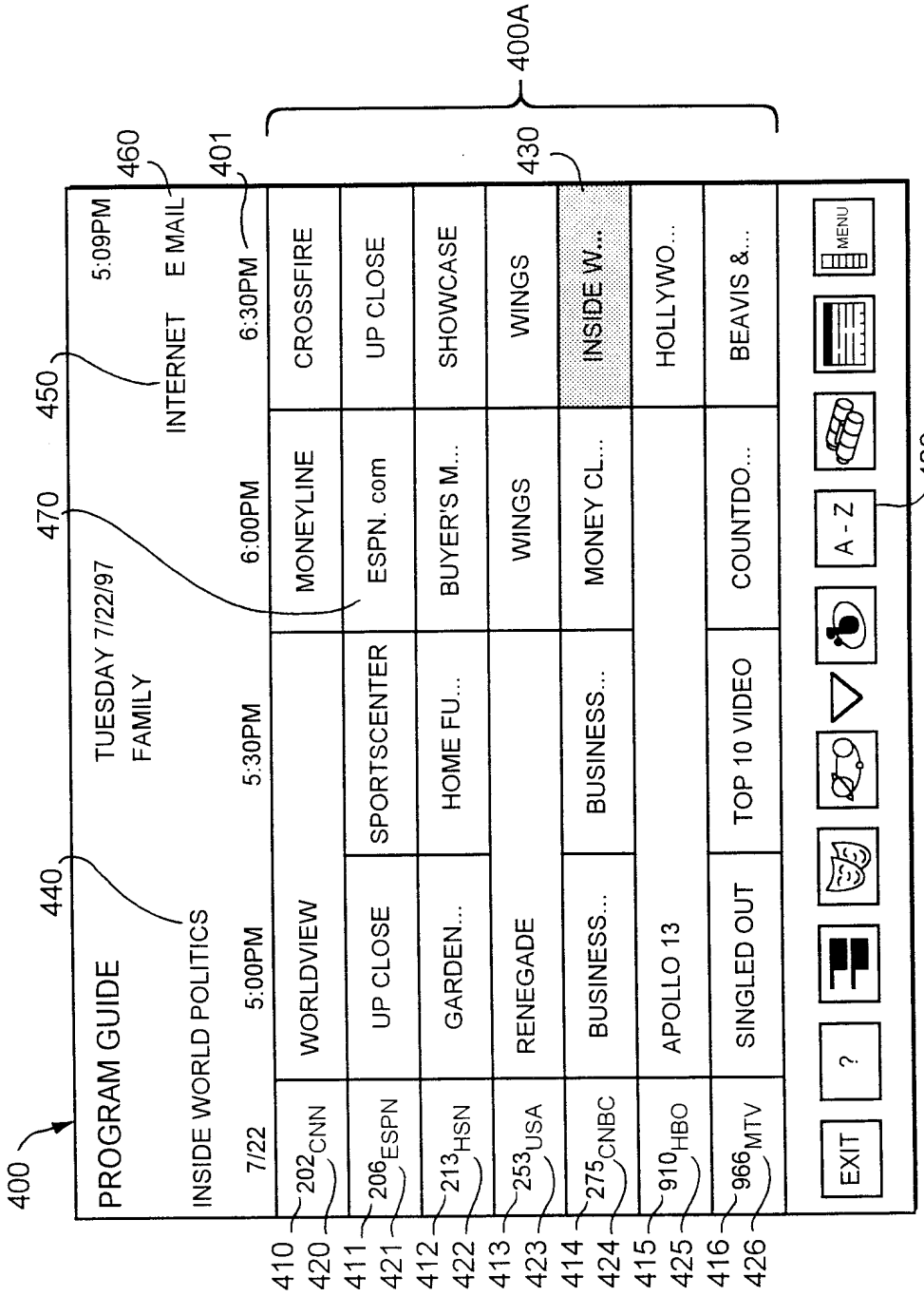

500
502
EXIT
HELP
A B C D E F G
H I J K L M N
O P Q R S T U
V W X Y Z - .
' & 1 2 3 4 5
6 7 8 9 0 < >
501
530
BACKSPACE
SPACE
CLEAR ALL
520 AUDIO PROGRAM
518 VIDEO PROGRAM
516 AUDIOVISUAL PROGRAM
514 COMPUTER PROGRAM
512 INTERNET PROVIDER
510 WEB-SITE
522 REMINDERS

FIG. 5


400
PROGRAM GUIDE
440
TUESDAY 7/22/97
FAMILY
INSIDE WORLD POLITICS
470
450
INTERNET E MAIL
460
5:09PM
401
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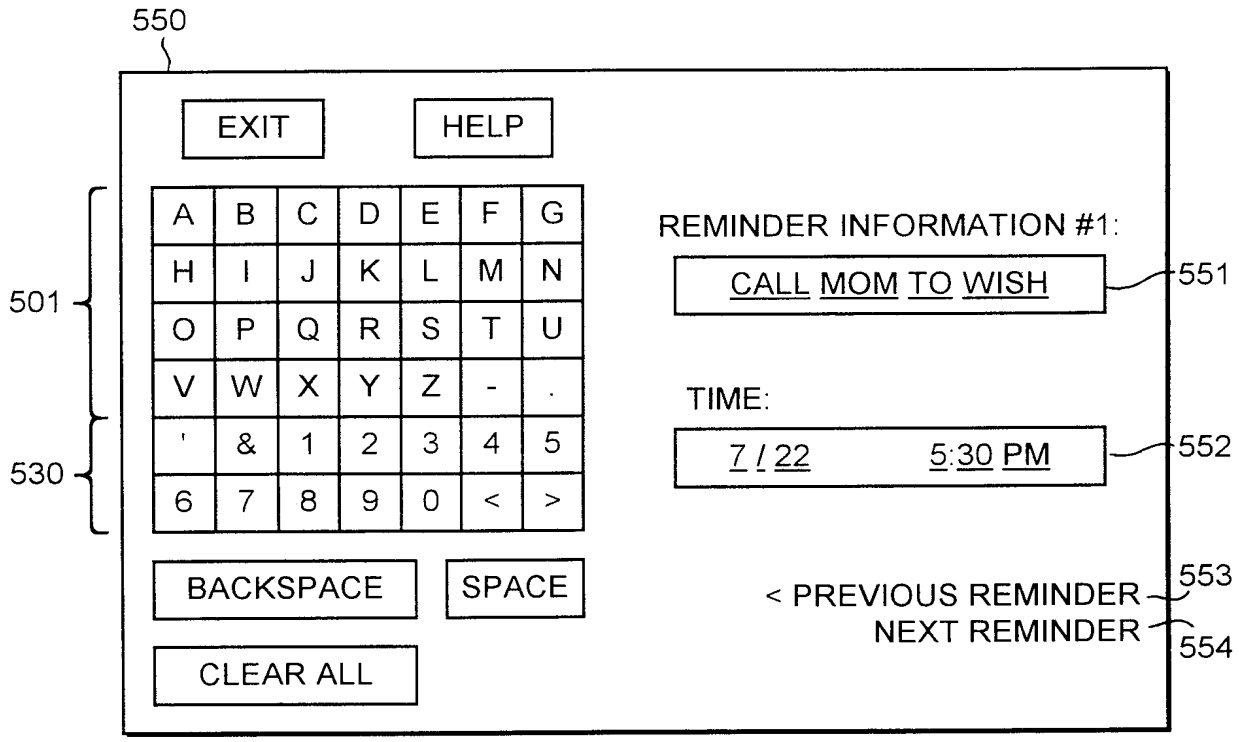
7/22
5:00PM
5:30PM
6:00PM
6:30PM
430
410
420
411
421
412
422
413
423
414
424
415
425
416
426
202CNN
206ESPN
213HSN
253USA
275CNBC
910HBO
966MTV
WORLDVIEW
UP CLOSE
GARDEN...
RENEGADE
BUSINESS...
APOLLO 13
SINGLED OUT
SPORTSCENTER
HOME FU...
BUSINESS...
TOP 10 VIDEO
MONEYLINE
ESPN. com
BUYER'S M...
WINGS
MONEY CL...
COUNTDO...
CROSSFIRE
UP CLOSE
SHOWCASE
WINGS
INSIDE W...
HOLLYWO...
BEAVIS &...
EXIT
?
A - Z
480
MENU

FIG. 4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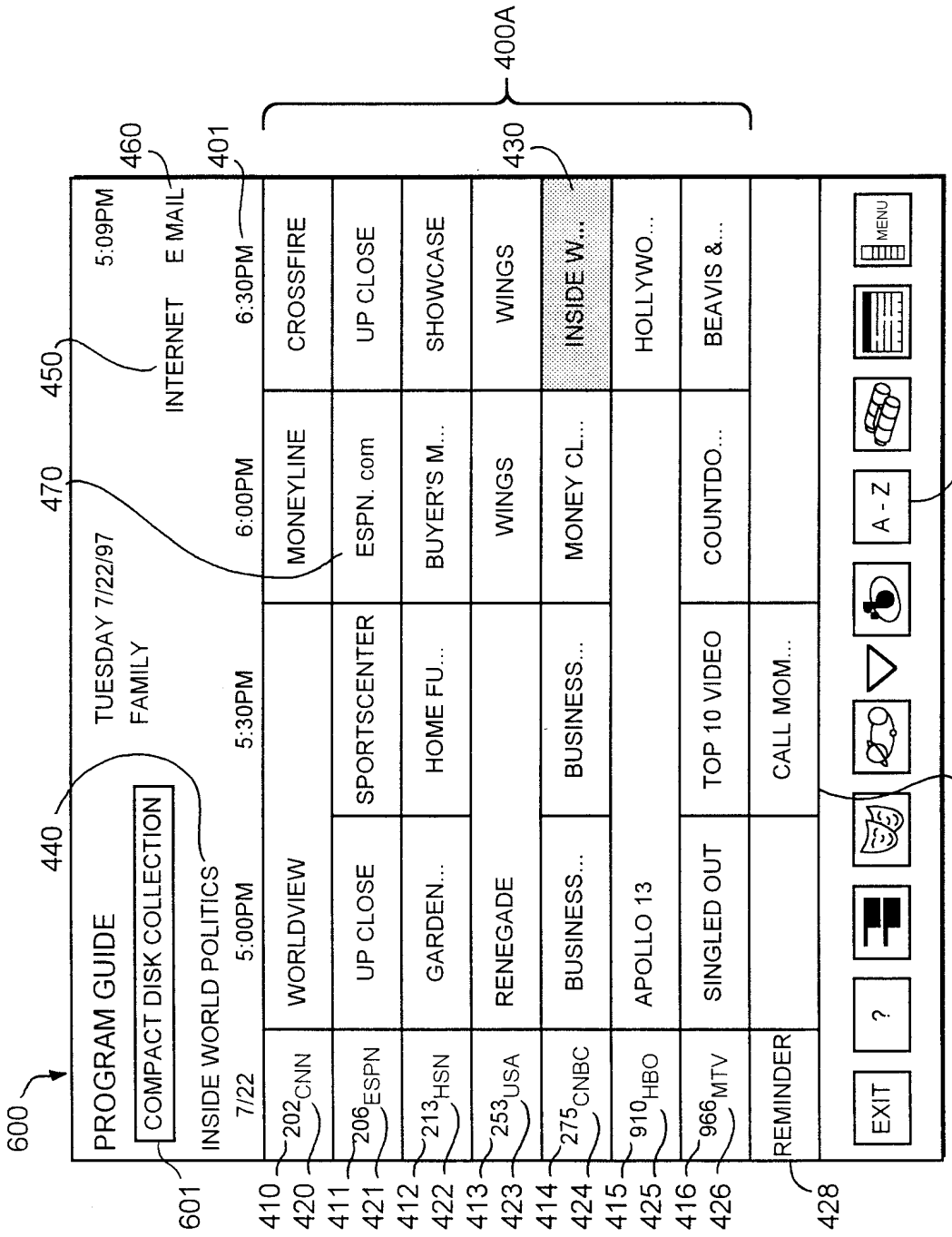
EXIT
HELP
A B C D E F G
H I J K L M N
O P Q R S T U
V W X Y Z - .
' & 1 2 3 4 5
6 7 8 9 0 < >
501
530
BACKSPACE
SPACE
CLEAR ALL
REMINDER INFORMATION #1:
CALL MOM TO WISH
551
TIME:
7 / 22 5:30 PM
552
< PREVIOUS REMINDER
553
NEXT REMINDER
554

FIG. 5A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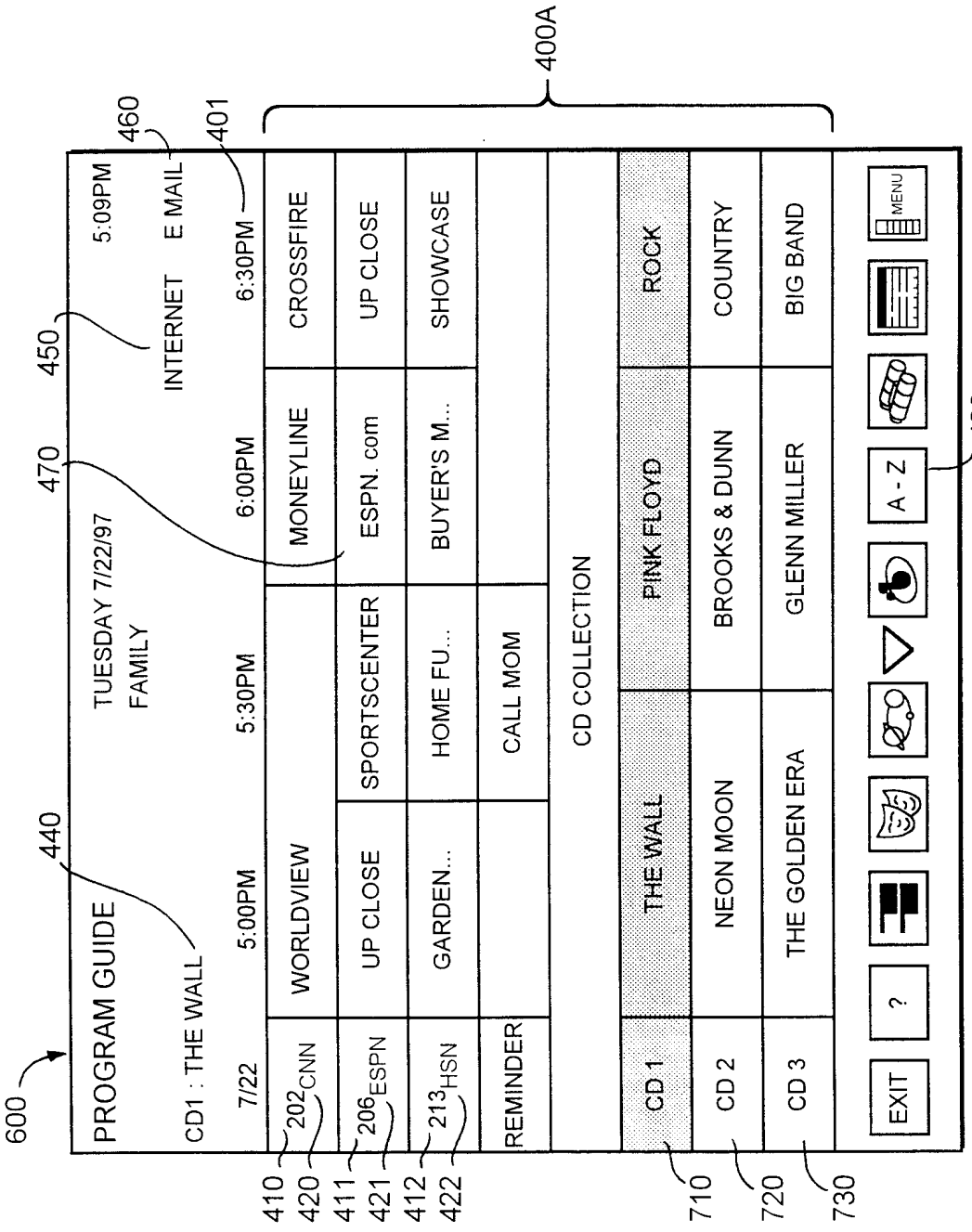
PROGRAM GUIDE
COMPACT DISK COLLECTION
INSIDE WORLD POLITICS
TUESDAY 7/22/97
FAMILY
INTERNET
E MAIL
5:09PM
440
450
460
470
400A
401
601
7/22
5:00PM
5:30PM
6:00PM
6:30PM
410 202 CNN
420 WORLDVIEW
411 206 ESPN
421 UP CLOSE
412 213 HSN
422 GARDEN...
413 253 USA
423 RENEGADE
414 275 CNBC
424 BUSINESS...
415 910 HBO
425 APOLLO 13
416 966 MTV
426 SINGLED OUT
428 REMINDER
MONEYLINE
ESPN. com
SPORTSCENTER
UP CLOSE
BUYER'S M...
WINGS
MONEY CL...
BUSINESS...
COUNTDO...
TOP 10 VIDEO
CALL MOM...
CROSSFIRE
UP CLOSE
SHOWCASE
WINGS
430
INSIDE W...
HOLLYWO...
BEAVIS &...
EXIT
?
A - Z
MENU
429
480

FIG. 6


600
PROGRAM GUIDE
440
CD1 : THE WALL
TUESDAY 7/22/97
FAMILY
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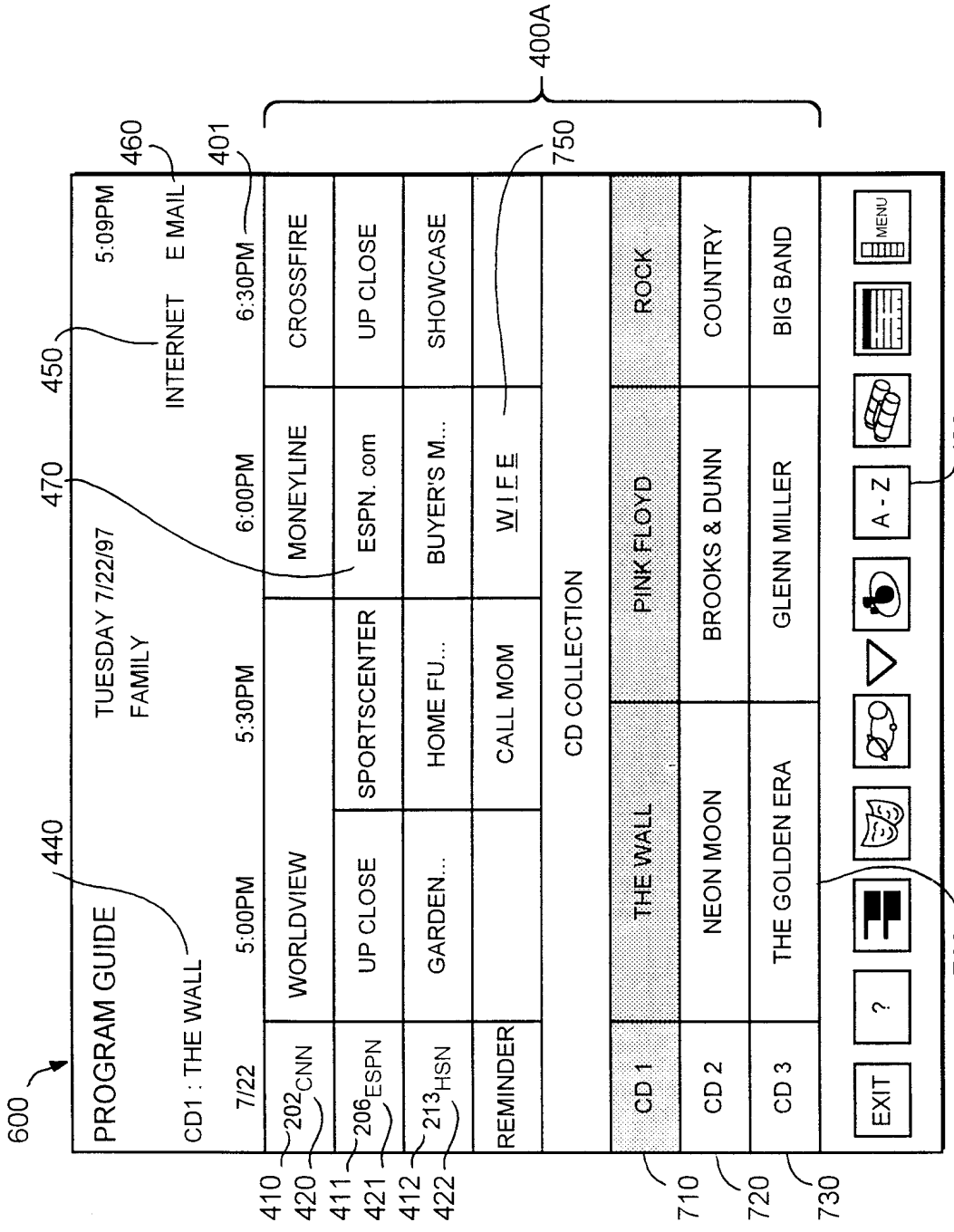
450
INTERNET E MAIL
460
5:09PM
401
400A
7/22
5:00PM
5:30PM
6:00PM
6:30PM
202 CNN
206 ESPN
213 HSN
WORLDVIEW
UP CLOSE
GARDEN...
CALL MOM
SPORTSCENTER
HOME FU...
MONEYLINE
ESPN. com
BUYER'S M...
CROSSFIRE
UP CLOSE
SHOWCASE
REMINDER
CD COLLECTION
410
420
411
421
412
422
CD 1
CD 2
CD 3
THE WALL
NEON MOON
THE GOLDEN ERA
PINK FLOYD
BROOKS & DUNN
GLENN MILLER
ROCK
COUNTRY
BIG BAND
710
720
730
EXIT
?
A - Z
MENU
480

FIG. 7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PROGRAM GUIDE
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TUESDAY 7/22/97
FAMILY
CD1 : THE WALL
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5:00PM
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6:30PM
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202CNN
206ESPN
213HSN
WORLDVIEW
UP CLOSE
GARDEN...
SPORTSCENTER
HOME FU...
CALL MOM
MONEYLINE
ESPN. com
BUYER'S M...
W I F E
CROSSFIRE
UP CLOSE
SHOWCASE
750
REMINDER
CD COLLECTION
CD 1
CD 2
CD 3
THE WALL
NEON MOON
THE GOLDEN ERA
PINK FLOYD
BROOKS & DUNN
GLENN MILLER
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410
420
411
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422
710
720
730
EXIT
?
A - Z
MENU
480
760

FIG. 8

# INTERNATIONAL SEARCH REPORT

In ıtional Application No
PCT/US 99/29775

**A. CLASSIFICATION OF SUBJECT MATTER**
IPC 7 H04N5/445 H04N7/16

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X<br>Y | US 5 699 107 A (MATTHEWS III JOSEPH H ET AL) 16 December 1997 (1997-12-16)<br><br>column 7, line 8 - line 16<br>column 12, line 1 - line 15<br>column 12, line 44 - line 51<br>column 13, line 7 - line 16 | 1,5,7, 18,20,22<br>2-4,6, 8-17,19, 21 |
| Y | WO 97 13368 A (BRIEN SEAN ANDREW O ;MILNES KENNETH ALAN (US); SCHEIN STEVEN MICHA) 10 April 1997 (1997-04-10)<br>page 4, line 1 - line 16<br>page 17, line 25 - line 29<br>page 18, line 7 - line 12<br>page 22, line 7 -page 23, line 15 | 2,3,8-13 |

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 28 April 2000 | 10/05/2000 |

| Name and mailing address of the ISA | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL – 2280 HV Rijswijk<br>Tel. (+31–70) 340–2040, Tx. 31 651 epo nl,<br>Fax: (+31–70) 340–3016 | Sindic, G |

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# INTERNATIONAL SEARCH REPORT

In .tional Application No
PCT/US 99/29775

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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| A | column 1, line 28 - line 39<br>column 5, line 21 - line 31<br>column 4, line 8 - line 30<br>column 8, line 48 -column 9, line 2<br>figure 7 | 16,17 |
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Im ional Application No
PCT/US 99/29775

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